Certain Errors
in

NAVIGATION.

Detected and Corrected

By Edw. Wright.

With many Additions that were not in the former Editions

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80 ... 256.

Additions

To this Edition that were

not in the former.

THe Table for the true dividing of a Meridian of the *Sea*-Chart, heer called the Table of Latitudes, made to every minute of the Quadrant, which in the former edition was to every tenth minute, from page. 14 to the 36.

2 Divers additions concerning the true graduating and making both of a general and particular Sea-Chart, and touching the use of the Table of Latitudes, in the 4, 5, 6, and 7 Chapter.

3 The angle of any Rumb or Helisphærical line with the Equinoctial being given, to find presently the Latitude thereof for any Longitude given, page. 46.

4 The Table of Rumbs more exactly calculated then before, and a Table of the eighth Rumb calculated to every tenth minute, and added to the former: from page. 25, to 54.

5 The use and making of the Sea-rings, from page. 75, to 79.

6 A Table of the Magnetical inclination, calculated to every degree of the Quadrant, together with the Geometrical demonstration of the making thereof.

7 To find the angle of the true Horizontal line, with the visuall line touching the roundnes of the Sea, at any heighth of the eye above the water, and to this end an Observation and demonstration for the finding of the quantitie of the Earths Semidiameter: from page 87, to 96.

8 A Table of Refractions of the Sun and fixed *S*tars, pag. 97.

9 The Table of Declination of every minute of the Ecliptick, newly and exactly calculated in degr. min. and seconds, to the greatest obliquity of 23 degrees, 31 min. 30 seconds, from pag. 100, to 115.

10 The Table of Observations of the Sun, corrected by his Parallax, from pag. 124, to 141.

11 The eccentricitie of the Sun, the place of his Apogæum, and Tables of his middle motions, found out and corrected according to the said observations in Chap. 20, 21.

12 A new Theorick of the Sun, and the manner of making the Table of the Suns Prosthaphæreses thereby, from pag. 154. 158.

13 New Ephemerides of the Sun for five years, and how to make them and continue them for many years past or to come, from pag. 159, to 168.

14 A new Table of the Suns Declination for the Mariners use, and how by certain Prosthaphæreses to continue the same for many years, from pa. 170, to 181.

15 The errors of *Simon Stevin* in finding fault with my Table of Rumbs, from the 214 pag. to the 224.

16 A short Treatise of the whole Art of Navigation.

17 A new and exact Table of the Suns Declination made, and to be used according to the ordinarie manner wherewith English Mariners have been most acquainted from pag. 67 to 80.

18 A most easie and exact way to find the true height of the Pole in any North Latitude, by knowledge of the heighth of the Pole-star, when the Guard is in any of those 8 ordinarie positions commonly noted amongst Sea-men: from pag. 81 to 90.

19 A Table of Observations of the variation of the Compasse, taken in all parts of the world almost whither any Navigation hath been made in our age! from pag. 91, to 101.

20 The Haven finding Art or the way to find any Haven or place at Sea, by the Latitude and Variation.

To the *Worſhipfull*

Captain *Thomas Whetſtone*

Eſquire.

Much honored Sir,

THe loving reſpects which your pains expreſſed to me-wards, when ſome occaſions urged me to make application to your Worſhip, hath ſo far obliged me, that I ſhould not acquit my ſelf of ingratitude if I ſhould let ſlip the opportunity I have to render your Worſhip Thanks:

And with all Sir, knowing your good affection to and perfection in Sciences Mathematical, and eſpecially that moſt neceſſary, moſt profitable, and Honourable branch thereof, Navigation; I further make bold to Dedicate this the third Edition of *Mr* Edward Wrights Correction of errors in the Art of Navigation, to the acceptance and Patronage of you moſt honoured Sir.

The Author in his Time thought it a Preſent for a Prince, nay a ſplendent and illuſtrious Prince, and therefore Dedicated it to the eldeſt Son of James King of great Brittain; *viz.* Henry, then Prince of Wales; whoſe budding vertues grow in you, whoſe Heroick ſpirit acts in you, and whoſe hopefull vallor and Corage powerfully and effectually manifeſts its ſelf in you.

But Sir, Its Patron is Dead, and ſo is the Elementary part of its Author; and a ſhame it were ſo worthy a work ſhould again enter on the ſtage of the world without either Author to own it, or Patron to Protect it: And therefore Sir, as this motive moved me (who am now become the Diſpoſer of the Book) to Dedicate it to your Worſhip, ſo let the

ſame argument perſwade you to accept its that ſo as the former Impreſſions have found a current vent, this the latter Edition may by your good Countenancing thereof, receive the quicker ſail, to the Profit of the Printer, the benefit of the Buyer, and the general profit and benefit of the whole Art of Navigation.

I deſire the Almighty to bleſs your Worſhip with health and proſperity, and to carry you along in all your Worthy adventures: I wiſh your encreaſe of Honor, and honourable actions; and that you may ſhine at Sea as a Star of the firſt Magnitude fixed in the Zeniths that ſo your Name may affright your Enemies, your deſerts engage your friends, and your Example be as a Whetſtone for all truly honourable, to ſet the edge of their vertues on.

I ſubſcribe my ſelf,

Your Worſhips moſt affectionate
and
humble ſervant.

Joſeph Moxon.

THE PUBLISHER TO THE READER.

WHen I considered the elaborate pains of that able Mathematician Mr *Edward Wright*, I thought it very uncommendable to our Englisn Nation that his so usefull a book should (as it were) sleep it self to death; and therefore for the benefit of Sea-men have I printed a third Impression.

I shall not need to enconiumize upon the skil of the Author, nor excellency of the work; many learned and famous men having already eased me of that Task; Nay the book it self tho others were silent (being the most Authentique Testimony) can speak for the abilities of the one, and accomplishment of the other.

Some perhaps may think that because the Tables of the Suns *Epemerides* and *Declination* were Calculated to the year 1608 &c. that they are for these present years useless, because of the lenghth of time that is since then already past; and therefore that they ought to be new Calculated to this present time: but herein they are over Curious; for our Author himself (then whom, I never heard of any man more precise) in an Example for finding the place and Declination of the Sun by those Tables, mentions a year yet to come, *Pag.* 171. and tells us that they will serve for many following years without any sencible error; which insencible error if the over nice will avoid, our Author hath not left him unfurnished with Rules sufficient for his purpose. Be-

sides if in the New Calculation there had bin any Difference (tho never so final) the Tables would not have agreed with the Observations that he made at that Time, nor the opperations that were wrought upon those Observations.

I have added the Treatise called *The Haven finding Art*, to the end of this book; the subject being both sutable and serviceable to every Sea-man, and the more Notable because of the great probability there is thereby to find the Longitude; which doubtless, if there be two such Magnetical Poles as our Countryman Mr *Anthony Linton* in his final Treatise intituled *News of the Complement of the Art of Navigation*, and divers other learned men have affirmed, (tho our Author herein Dissent from them) then may it not be very Difficult by the Latitude and Variation of the Compass observed to find the Longitude. I confess it may be thought that that opinion may be refuted by the Variation of Variation; But Time who hath lately revealed the Variation of Variation, hath also discovered the Regularity of the Motion of this Variation: by which, the Variation of any Place being already known, may be Calculated what the Variation shall be for any year to come. But it were to be wished that this knowledge had bin revealed to our Author Mr *Wright*, or some other so publique spirited as he was.

Another way of finding Longitude there is, and that is by Celestial Observations, lately set forth by *Andreas Berlicome* of *Rotterdam*, which indeed I have translated into English, and intended to have annexed to this Book; but two Considerations Diverted my purpose, the one was, because the way *Berlicome* shews, was long since set forth by a Countryman of our own; *viz.* Mr *Anthony Linton* aforesaid, and therefore I was unwilling to applaud a Stranger for the Credit an English man had Deserved, The other Consideration was because

causethose Observations cannot well be made at Sea, in regard of the Ships continual Tossing; and therefore not usefull for Sea-men.

Thus Courteous Reader wishing you to mend such litteral faults with your pen as may have escaped the Press, I commend the book to your acceptance, and desire, that as formerly the name of Mr *Wright* hath bin famous all the world over, where Navigation doth florish, so still his memory may be remembred, and every leaf of this book may be as so many Heraulds to proclaim the worth and Deserts of so excellent a Man.

Farewell,

Joseph Moxon.

The Preface to the Reader.

THE Art of Navigation (as it is called) though it hath now been in uſe ſome thouſands of yeeres, yet how farre it is at this day from the perfection which is and were to be deſired, wee would ſcarce beleeve (as a wonder that a thing of ſo great commoditie, ſhould no more be ſought into, in ſo many ages:) but that both the bookes of the learned are extant, to teſtifie, and reaſon (approved by often triall) doth plainly ſhew that the principal meanes, and Inſtruments this Art uſeth, have been thus long ſo farre from this perfection, that contrariwiſe they have been and are much ſtained with many blots and blemiſhes of error and imperfection.

1 The Sea-Chart (the beſt meane the Mariner hath to know the courſe from place to place) as it hath bin hitherto generally made, is ſo faultie in the very foundation and ground-work thereof (that is, in the Geometricall lineaments of the Meridians, Parallels, and Rumbs deſcribed therein) that hereof there may ariſe ſo groſſe error, as may cauſe the Mariner to miſſe one, two, yea three whole points of the Compaſſe (and more ſometimes in a farre Northerly or Southerly Navigation) in finding the courſe from place to place. Whereof it may alſo be neceſſarily inferred, that following the direction of his Chart, in ſuch ſort as hath been uſed for finding the diſtances of places, he may erre twice, yea thrice ſo much as the whole diſtance commeth to, and more ſometimes in thoſe Northern parts, in taking the diſtance to be twice, thrice, yea foure times greater then indeed it is.

2. *The Compass, the chiefest Instrument for keeping the course shewed by the Chart, by the Variation neglected (as by some it hath been) may cause you erre an whole point or two in the courses of divers places: and not rightly used, hath bred much confusion in many parts of the Chart, in laying out many places in false courses: which must needs follow when the Chart is made according to the direction shewed by the points of the Compasse, without abatement or alowance, answerable to the variation in every place. This may especially be seen in those places where the variation is greatest; as upon the coast of* Florida, Nova Francia, *and New-found land: where some also seeking to avoid this inconvenience, have fallen into another as ill or worse then the former, in making a double scale of Latitude. And thus one error as a fruitfull mother breeding another, and one absurditie admitted drawing many with it: it will manifestly appeare by exact discourse out of these grounds (that partly through the false projection of the Chart, and partly through neglecting, or not rightly using the variation of the Compasse) that it cannot otherwise be, but that the ordinarie Charts are in many places much like an inextricable labyrinth of error, out of which it will be very hard for a man easily to unwinde himselfe.*

Hereto accord the often experiments and usuall practise of many well experienced and judicial Mariners and Seamen of our time, who confesse that in sailing from the West Indies *to the* Azores, *they have often fallen with those Ilands, when by their account, according to the Chart, they should have been* 150, *or two hundred leagues to the Westwards of them. The like hath been found in sailing from the* Azores *for* Vshent, *as I have also partly seen in the little experience I have had at Sea; where we were come within sight of that Iland, when by account of the ordinarie Chart we should have been fiftie leagues short of it*

And as concerning the Courses from place to place, I have observed that some of our Masters take a wise course, in not trusting to those courses which are shewed by their Charts. But first getting themselves into the height or Parallel of the place to which they are going, and withal knowing assuredly whether they be more Eastward or Westward then that place; they then proceed, alwaies heedfully keeping themselves under that Parallel till they come to the place desired. Then which way of sailing there is none more certaine and infallible, for the sure finding of the place assigned: but it hath this inconvenience, that it maketh the way

longer

longer then otherwiſe in ſhould be, if the ſtraight courſe where kept.

But to returne to that from whence wee have a little digreſſed: by theſe experiments and practiſe of the skilfulleſt Mariners, it is manifeſt that they themſelves doe often find the imperfections of their Charts, in ſhewing the courſes and diſtances of many places each from other, wherto we may adioyne the experience of the beſt Hydrographers *of our time, who daily making their Charts after the accuſtomed manner with ſtraight lined rumbes and degrees of Latitude every where equal have found ſuch difficulties in labouring to bring their Marine deſcriptions to ſome due correſpondence of truth in the courſes, heights, and diſtances; that tired herewith in the end, they have holden it impoſſible, to make the Chart agree in all theſe with the Globe. Wherein notwithſtanding they erre, by making too generall a concluſion, in holding that to be ſimplie impoſſible, which cannot be done by ſuch a way and meanes as they know and uſe.*

3 *The Croſſe-ſtaffe, the principall Inſtrument, that hath at Sea been moſt generally uſed, for obſerving the Altitudes of the Sunne or Starres, thereby to know more aſſuredly the Latitude, and ſo to examine and rectifie the account of the courſe kept by direction of the Compaſſe upon the Chart, if there be not abatement made anſwerable to the eccentricitie of the eye (that is, to the diſtance wherewith the center or point wherein the ſight beams concurre within the eye is further backward then the end of the ſtaffe) may through neglect of this abatement cauſe error in taking the height obſerved to be greater then indeed it is by 10,20,30 minutes, yea an whole degree, and more ſometimes, if the height be much, the ſtaffe ſmall, and the eccentricitie of the eye great.*

4 *But both this ſtaffe and all other Inſtruments (though never ſo well made and uſed) can do us but ſmall pleaſure, for finding the Latitude at Sea, if the declination of the Sunne and Starres which wee obſerve be not alſo known. To this end therefore there have been made tables of the 'Declinations, both of the Sun and fixed Starres: yet ſuch as even that which hath been publikely commended, as not differing from truth in any place above one minute (I mean the Regiment of the Sun, ſet forth by* R. N.*) doth notwithſtanding differ from truth in many places eleven, twelve, or thirteen minutes. And as for the fixed Starres, ſcarce one of them hath his declination truly ſet down, and agreeable to obſervation. Yea even the Pole-ſtarre it ſelfe, though it*

be better known and more observed by the most part of Seamen then all the rest; and indeed as it might be used (being to be observed at any time of the night all the yeere long) might stand them in as much stead for finding the Latitude as all of the rest almost: yet in the bookes of Navigation that are most common amongst English Mariners, the distance thereof from the Pole is made to be in our time above 40 minutes more then it should be. No marvell therefore if the Mariners complain (as I have heard them sometimes) that they cannot make their observations of the Latitude, by the Sunne and this Starre to agree.

Neither is there more truth to be looked for in the declination of many other principall fixed Starres, published in those bookes, divers of them erring from truth one, two, yea (some of them) three whole degrees and more, as in the treatise following shall be shewed. And these errors in the declination of the Sunne and fixed Starres, not only I, but also the right worshipfull Sir Christopher Heydon *Knight, and the noble Lord of* Knudstrupp, Tycho Brahe *founder of* Vraniburg, *with the gratious Prince* William Landtgrave *of* Hassia, *father of him that now is, have often found by many and most diligent observations, with large and exact Instruments, wherein both minutes and halfe minutes might be easily discerned. Notwithstanding, if any stand in doubt hereof, I wish that he himselfe also would bestow no lesse cost, time and diligence to make often heedfull and exact observations then either the* Prince *of* Hassia, *or* Tycho Brahe, *or at least as I my selfe have done; and then, let him beleeve that which he shall see to be true with his own eyes.*

These errors therefore in the Chart, Compasse, Crosse-staffe, and declinations of the Sun and Starrs, I have in the treatise following laboured to reforme to the utmost (yea rather beyond the utmost) of my poore abilitie, neglecting in the meane time other studies, and courses that might have been more beneficiall to me: which may argue my good will to have proceeded further, to the amendment of such other faults and imperfections as yet remain, besides those that are alreadie specified, and that especially in two points, that is, in the courses, and Longitudes of places.

The reforming of the Chart in reducing all places from those varying courses, wherein now they are set down, to the true positions they have each from other, by separating the variation (wherewith they are in the ordinary Charts for the most part intermingled) were a busie peece of work: yet as were most worthie,

thie, and neceſſarie to be laboured in, as without which the Charts, Maps, and Globes, or any other Hydrographicall or Geographical deſcriptions, cannot be freed from many intricate abſurdities, wherewith now they muſt needes in many parts be peſtered: becauſe the courſes and poſitions of places are in them ſet down as they were obſerved by the varying Compaſſe, without ſeparating the variation afterwards, that ſo the true courſes and poſitions of places might be known.

The Longitude alſo would well deſerve both labour and coſt to be both skilfully and liberally beſtowed, for the finding thereof, whereby it were poſſible to bring it to that paſſe (the motions of the Sunne and Moone, and places of the fixed Starres being verified, whereof that noble Tycho Brahe hath afforded great hope) that the induſtrious and willing minded Mariner might be capable thereof, in ſuch ſort that for the moſt part, when the Moone and fixed Starres appeare, he might be able hereby to know what Longitude he is in (yea even at Sea) more truly then many have done by their dead reckonings in ſailing out of the bay of Mexico to the Azores, or from New-found-land to England, or almoſt from the Azores to England. But on land the Longitude might by this meanes be found exactly as the Latitude hath been by many obſervers at Sea. And ſo opportunities of obſervation with meet Inſtruments on ſhoar, not being neglected, (eſpecially in long Voyages, farr Eaſtward or Weſtward) many moſt notorious errors in the Longitudes of places would in ſhort time be corrected, wherewith the moſt excellent arts of Geographie, and Navigation are very much blemiſhed. For who that loveth truth, can patiently endure to heare the Mariners common and conſtant complaint of 150, or 200 leagues error in the diſtance between the bay of Mexico and the Azores; or (that which is yet moſt intollerable and monſtrous) of 600 leagues difference in the diſtance between Cape Mendoſino and Cape California, ſome making that diſtance to be twelve or thirteene hundred leagues, where others will have it (and that more probably) to be no more then ſix or ſeven hundred.

But for as much as the charge, though not great, (to ſpeake of) of providing meet meanes for ſupply of theſe wants in the courſes and Longitudes, (but chiefly in the latter) exceeds the meane abilitie of the moſt part of them that are moſt addicted to theſe ungainfull ſtudies (I muſt not ſay ungratefull, although in theſe daies they prove moſt unprofitable to their greateſt lovers) therefore they are for my part like to reſt (as hitherto they have done)

untouched, and only commended unto a certaine kind of hope (whether vaine or no I know not) of ſome Mecænas at length of manificent ſpirit to be ſtirred up, to have ſome due conſideration both of theſe, and other ſuch wants and imperfections, as yet remaine in ſo excellent an Art as this of Navigation is.

For ſurely there is no man (conſidering how many other both ingenious and ingenuous, as well Liberall as Machanicall Arts doe yeeld their aid and ſervice unto this of Navigation) that can denie the excellencie thereof, or the profitablenes either. But if he will, my purpoſe is not to ſtand upon it, nor to convince him by reaſons, by records, or by the more wonderful diſcoveries that have bin performed in this our age, even to the furtheſt parts of all the earth, and round about the whole compaſſe of the ſame, whereby we have been made partakers of the moſt rare and richeſt commodities and treaſures of the utmoſt Indies and Iſlands of the world, and they likewiſe have participated with us (or elſe they have had the more wrong) in the moſt precious treaſures of heavenly truth. All which and much more then can be thought, or now ſpoken of, performed chiefly (next under Gods providence) by the rules and directions of this art, who ſeeth not that by how much the more excellent, and unto mankind abundantly profitable it is, ſo much the leſſe ought any notorious error to be tolerated therein, and ſo much the more ought all whom it may concerne (yea but in good will only where it may doe good) to endevour themſelves that it may be brought to the higheſt pitch of perfection. I know not then if any one be unto ſo excellent an enterpriſe drawn on to give the beſt furtheranee he can, why he ſhould for his labour fall into any danger of reprehenſion at all. Yet it may be, I ſhall be blamed by ſome, as being too buſie a fault-finder my ſelfe. For when they ſhall ſee their Charts and other Inſtruments controlled, which ſo long time have gone for currant, ſome of them perhaps will ſcarcely with patience endure it. But they may be pacified, if not by reaſon of the good that enſueth hereupon, yet towards me at the leaſt, becauſe the errors I point at in the Chart, have been heretofore complained of by others, eſpecially by Martin Corteſe. and Petrus Nonius, out of whom moſt part of the firſt Chapter of the Treatiſe following is almoſt word for word tranſlated; I for my part deſiring rather that faults ſhould be found by others then by my ſelfe, and labouring much more, as for a thing much better, and far more needfull, and profitable, to be a fault-mender, then a fault-finder. Or elſe I may ſo much the more be miſliked, becauſe in ſeeking to amend, ſome will

think

thinke I take too much upon me: For ſome will ſay, and of thoſe perhaps that have been employed in Sea affairs all their life long, that all this we goe about is more then needs. For they without all this ado have ever performed their charge with good ſucceſſe, and are now too old to give eare to theſe innovations and new ſchoole tricks. But other Sea-faring men who acknowledge the need hereof, are aſhamed peradventure to receive (as it were) either correction from the ſchooles, or direction from the land: and therefore ſtick not to condemne Vniverſities, and all in compariſon of their long and daily experience. Others alſo as more indifferent for the matter, will yet have a fling at the perſon, thinking this reformation, which is profeſſed, to ſpring out of other mens fountaines: All which (becauſe wee are now about a work of amendment) muſt alſo (if they will heare reaſon) amend their opinions. For the firſt, which ſeem moſt unreaſonable, do not conſider (being addict to theſe unreformed Inſtruments) how like they are to thoſe old ſhip-maſters, of whom Maſter Bourne *maketh mention, who not many yeeres ſince, wedded likewiſe too much to their old accuſtomed uſage, have mocked them that have uſed Charts, or Croſſe-ſtaves, ſaying, they cared not for their ſheep-skinnes, they could keep a better account upon a boord: and them that obſerved the Sunne or ſtarres for finding the Latitude, they would call Sun-ſhooters, and Star-ſhooters, and aſk if they had hit it. But marke what commeth hereof: for one of theſe Maſters was he, as I take it, of whom an ancient Seaman (yet living, as I think) once told me, who having undertaken the charge of conducting a ſhip from* England *to Saint* Michaels, *(the Eaſtermoſt of the* Azores) *and after long ſeeking, not able to find it, for ſhame and ſorrow caſt himſelf over boord. Wherefore theſe men, if they conſider it well, have no cauſe to boaſt of ſucceſſe without skill; but to thank God for both, that is, for their great and often good hap and ſafetie, and for their skill alſo were it ſmaller then it is. For I will do them no wrong, but doe freely grant and acknowledge, that from any one place to other, the courſe, height and diſtance may be truly ſet down in the ordinary Chart, wherein the Rumbes are right lines, and the degrees of Latitude every where equal: and ſo by that Chart they may ſaile truly enough from hence to* Ruſſie, *or* Iſland, *or any other place. But if by the way they ſhould croſſe over from the one to the other, following the direction that their Chart ſheweth them, they cannot but erre a great deale, either in courſe or diſtance, or both; eſpecially in thoſe Northerly Navigations.*

Why

Why then ſhould they, where there is danger of wandring, refuſe helpe of any that is willing to ſhew a better courſe.

But to come to thoſe that may perhaps object I doe but actum agere, *in doing no more then hath bin done alreadie by* Gerardus Mercator *in his univerſall Mappe of the World many yeers ſince: and in publiſhing ſomething already ſet forth by* Iodocus Hondius, *in his greater Mappe of the World and of* Europe, *now of late: I muſt anſwer, that indeed by occaſion of that Mappe of* Mercator, *I firſt thought of correcting ſo many, and groſſe errors, and abſurdities, as I have alreadie touched, and are hereafter at large ſhewed in the common Sea-Chart, by increaſing the diſtances of the Parallels from the Æquinoctial towards the Poles, in ſuch ſort, that at every point of Latitude in the Chart, a ſmall part of the Meridian might have the ſame proportion almoſt to the like part of the Parallel, that it hath in the Globe. But the way how this ſhould be done, I learned neither of* Mercator, *nor of any man elſe. And in that point I wiſh I had been as wiſe as he in keeping it more charily to my ſelf. For ſo perhaps it might have been more beneficiall to me: neither ſhould any man have had cauſe to thinke at the firſt ſight of the fourth Chapter of this book, that all I have there ſet down is ſtolen out of one of the foreſaid Mappes of* Iodocus Hondius. *But were I brought before a Iudge, I ſhould for my abſolution, and* Iodocus *his condemnation, make the contrary to appeare, and that by his own confeſſion in his letters to me, and to a friend of mine, which I have to ſhew; written in Latin with his own hand: To me his writing engliſhed is thus much in effect:*

I heare that you are ſomewhat offended with me, becauſe I have taken thoſe few things out of your manuſcript book, whereas I promiſed you that I would not publiſh it: which alſo I would in no wiſe do without your leave. For my conſcience ſomething grudged, even to publiſh this little, if the diſtance of places would have ſuffered me conveniently to ſend letters unto you. I was purpoſed to have ſet this forth under your name: but I feared that you would be diſpleaſed therewith, becauſe I have but rudely tranſlated it into Latine.

And in a letter to M. Briggs, *now Profeſſor of Geometrie in* Greſham Colledge, *he writeth thus:*

I have written to M. *Wright* in excuſe of my ſelf; I am very ſorry that he is angrie with me for that cauſe. I pray you learn of him how he is affected towards me, and write back unto me, and excuſe me unto him as much as you can. I would have publiſhed

liſhed his whole book for the common good, if I might have done it without breach of my faithfull promiſe. And ſurely my conſcience grudged to publiſh even this little which I have taken out of his book: but the profit thereof moved me, &c.

The truth is, that at his own inſtant requeſt, when he wrought as an Ingraver here at London, *ſome of my friends alſo procured by his flatterie, perſwading me thereto, he alſo aſſuring me upon his faith and credit that he would not publiſh it, or any part thereof without my knowledge and conſent. But how well and honeſtly he hath performed that proteſtation grounded upon faith and credit, the World may now ſee: and how unthankfull he hath been to me for that which hath been ſo gainfull to himſelf, (as may appeare by ſo common ſale of his Mappes of the World, of* Europe, Aſia, Africa, *and* America, *all which had yet been unhatched, had he not learned the right way to lay the ground work of them out of this booke) I my ſelf know too well. But let him goe as he is.*

Now if any ſhall think it to be beyond a Land-mans skill, to find faults in matters belonging to the Seamans profeſſion; they muſt know, if they be yet to learn, that one that is but reaſonably well acquainted with Geometrical *conceits, may as well, if not better then moſt Seamen, know the nature and properties of the ſpharical form of the Earth and Sea, with all conſequents and dependances thereof. By conſideration whereof, the true underſtanding and reaſon of the Nautical Planiſphere, or Sea-Chart, may by him that hath been but meanly converſant in* Mathematical *meditations, be better apprehended, then otherwiſe it can by the Seafaring man, though he ſpend his whole life in ſailing over all the Seas in the World. The like may be ſaid of the Croſſe-ſtaffe, and Compaſſe, and of the Regiments or Tables of Declination of the Sunne and fixed ſtars, and of all other the principall means and Inſtruments ſerving for the Art of Navigation. But it is ſtrange to ſee the difference of things that in this World is made by the difference of hands from which they are received, howſoever the things themſelves be. For let* Hannibal *a Captaine diſcourſe of Warlike affaires, be it never ſo ſlightly and out of reaſon or ſeaſon, yet all (forſooth) muſt needes be greatly eſteemed and admired, becauſe he ſo great a Captaine hath ſpoken it. But let* Phormio *a* Philoſopher *ſpeake of the ſame matter, eſpecially in the hearing of* Hannibal, *be his ſpeech furniſhed with never ſo much learning and Judgment, yet muſt he (there is no remedie) be either a foole or a madman for his hire. So by all*

likelihood, the case may stand with this poore Treatise of mine; which if it had come forth to publike view, from out of the bosome (as once it was like) of a Master at Sea, of great reputed excellencie, it had no doubt then found the favour, which now like enough it shall want: all windes then would have sweetly blown it into the pleasanteſt haven of every mans (at leaſt of every Sea-mans) favourable entertainment. I shall therefore with their patience set down the matter as it was, that none may mistake a truth, which is daughter, not only of time, but of occasion, as hereby may appeare. It is not unknown to some of good place and reckoning, that one of the skilfulleſt Navigators (as he was by many accounted) of our time and Nation, (who died in Sir Francis Drakes *laſt Voyage) when he came to that extremitie of ſicknes, that he ſaw there was no other way with him but one, was reported to have gathered and bound together into a bundle all his Nautical notes and obſervations, and to have caſt them into the Sea. But ſoon after, notwithſtanding that report, there came more comfortable newes by a Captain that was familiarly acquainted and converſant with him in all that Voyage, and during the whole time of his ſicknes, in whoſe armes alſo he died: who moving ſome ſpeech unto him touching ſomething of Sir* Francis Drakes, *that might then after his death be expected to come to light concerning Navigation;* Tuſh (*ſaith hee*) for that matter there is not much to be looked for at his hands, he had but ſmall ſkill in that Art. *Why, and what will your ſelf then do: (quoth that Captain) Whereupon this great Navigator drew forth a book out of his boſome, and delivered it to this Captain a little before his death. This book was ſhewed by the ſame Captain to the Right Honourable the Lord high Admiral of England in the* Cales *Voyage, as being made by that famous Navigator, which his Lordſhip alſo (as it was reported) thought good ſhould be peruſed and publiſhed. Theſe news moved ſome expectation of that book; ſo as the Right Honorable the Earl of* Cumberland *hearing of it, was deſirous alſo to have a ſight thereof, and remembred me unto that Captain, as one not inſufficient to peruſe and correct the ſame. And hereupon the book was brought unto his Lordſhip, at the time and place appointed at* Weſtminſter, *and was there alſo delivered unto me to be peruſed and corrected. Having therefore opened it, and beginning a little to turn over the leaves, to take ſome general view what matter might be contained therein: I firſt eſpied a Diagram, the like whereof I knew very well I had made in a book of mine. And herewithall I was the more moved*

to

to see if there were any more that I could know as well as the former: turning over therefore two or three leaves more, I presently espied another figure also, wherewith I was as well acquainted, as with the former: for I found not only the very same figure, but (that which made me the more to marvel for the present) following also in the same order, as I well remembred it did in my book. Being therefore yet more earnestly stirred up hereat, and wondring what the reason might be, that we should thus agree, I betook my self to the reading of that book. And looking first upon the first leaf thereof, and afterwards in many other places, I found it every where to agree with mine, and to be a coppie of the same book, word for word, which I made, and presented unto his Lordship almost seven years before, as the next morning it plainly appeared, both to his Lordship and to the Captain himself that brought it, by comparing it in all points, with the original exemplar of the same book, which I then brought unto his Lordship.

One crime there yet remaineth which Simon Stevin of late hath charged me with, in the former edition of my Tables of Rumbs, namely, that I have erred about 12 minutes in the Latitude of the fourth Rumb at 78 degrees of Longitude, and above two minutes in the Latitude of the first Rumb from the Meridian, before I come to so little as two degrees of Longitude: whereby hee would prove that my way of making the Table of Rumbs should be erroneous. But the truth is, the error is not so much in my Tables, as in his own too rash unadvisednes, who out of no better ground then so grosse a manner of trial, as he useth in finding out the Latitudes of the Rumbs, working by whole degrees of Longitudes, would make the world beleeve I had committed so great errors in those Tables; which Latitudes if he had sought by single minutes, he should not by his own way and manner of account have found so much as the sixtieth part of one minute difference from my way whereby I made those Tables; which as it is of all other the most easie, so it is not inferiour in truth to any way that he hath or can devise: his account, according to his own waies, yeelding alwaies more then truth, and mine something lesse; and yet not differing so much as one second one from another, if you work his way exactly by small differences of Longitude.

But I fear that whilest I labour to satisfie all, I shall offend some, as making too long a Preface to so smal a volumne: I will therefore hasten to an end: Only shewing the sum of this Treatise; which I thought good to offer unto your view, as a short abridge-

ment of all that followeth, and rather to set it apart by it self, then to include it, as I was purposed, within this Preface, which is beyond his bounds already.

The summe of the Treatise following.

THe Treatise following containeth four principall parts; whereof the first may be called Hydrographicall; wherein are set down the errors of the common Sea-Chart, with right lined Rumbs, and degrees of Latitudes every where equal: then the way to avoid these errors is Geometrically demonstrated, and out of this demonstration a Table is calculated and the use thereof shewed, for the true and easie dividing of the Meridians in the Chart, both general and particular, into single minutes of Latitude, increasing in due proportion towards the Poles, whereto is adjoyned, as arising from thence, the Table of the seven first Rumbs, shewing by what points of Longitude and Latitude each of those Rumbs is to be drawn, from the Equinoctial till you come within a minute of the Pole: with help of which Tables, the Rumbs may in any Chart, Mappe, or Globe, much more truly be described, then by those machanicall waies, long since published by Petrus Nonius, or lately practised by some Globe-makers in England. To which is annexed a Table of the eighth Rumb, shewing the quantitie of one degree of Longitude at any Latitude, in minutes seconds and thirds of one degree of the Equinoctial. Which degree of Longitude being divided by 3 at any Latitude, giveth you the number of leagues contained in one degree of the Parallel at that Latitude. By meanes of this Table, the Table of Rumbs may (according to Stevins way) be more truly and easily made or examined, then by that which he hath lately set forth, 4 libr. Geogr. de Histiodromia. After this followeth a most plain and sensible demonstration of the disagreement of the common Sea-Chart, and of the agreement of the Globe with the Chart before described, the use of which Chart is shewed in the Chapter next following: where also (the Longitudes and Latitudes of any two places being given) the way is set down how to find their distance, measured either in the segment of the Rumb, or in the arch of the great circle that is drawn between them, both mechanically with Ruler and Compasse, and Mathematically by the doctrine of Triangles; whereby it may without much difficultie be conceived how Navigation may by Arithmetical calculation only be performed without Chart or Globe, the Longitudes only and Latitudes

titudes of the places from whence you come and whither you go, being first known.

The second principal part of this Treatise may be called Magnetical; *because it intreateth of the Variation of the Compasse, shewing how the same may be found at Sea (the Latitude being given) by one observation of the Suns height, and point of the Compasse whereupon he is at the same instant, before or after noon, with help of the Globe or Astrolabe: which way of finding the Variation is also exemplified, with a Table of such observations as I took both at Sea and on shoar, in the Voyage of the Right Honorable the Earl of* Cumberland, *in the year 1589. But this way of finding the Variation, being something tedious, I have now therefore hereto newly adjoyned the making and use of the Seamans Rings; an Instrument which long since I devised for the present finding both of the Variation and time of the day, at one instant, even together with the observation, without any further trouble of using any other Instrument, or working, either Mechanical or Arithmetical, after you have observed. Yet because these Rings, and the Globe and Astrolabe also are such Instruments as every one cannot easily have and use at Sea; I have further shewed how by the Suns point of the Compasse (or Magnetical Azimuth) and altitude given by observation the Variation may be found, either mechanically, with Ruler and Compasse, or Mathematically by the doctrine of Triangles, and Arithmetical calculation. And seeing moreover that of late years, divers industrious Seamen of our Nation, have begun to make some observation of that new found propertie of the magnetical needles inclination, or dipping under the Horizon, after it is touched with the Loadstone; by means whereof, it seemeth something probable, that Seamen may have some help to know their height or Latitude in dark and cloudie weather, when neither Sun, nor Stars for many daies appear, to be observed: I thought it should not be impertinent to this place to set down the Theorick that hath been devised of this magnetical inclination, together with a demonstration for the making of a Table thereof, to every degree of Latitude, according to that Theorick; to the end that such of our Sea-men as mean to be diligent observers hereof, may make heedfull trial of that inclining propertie: and compare the same with this Table, in all parts of the world where they shall travell; especially in those long Voyages to the East and West* Indies, *and in their Northeast or Northwest discoveries.*

The third part may be called Geometrical *intreating of the*

Crosse-staffe, and shewing how such errors may be avoided, as have been commonly committed in the use thereof, either by reason of the parallax, or eccentricitie of the eye, or by the height of the eye above the water, or by the parallax or refraction of the Sun. And because for finding the quantitie of the angle that is to be abated out of the apparent altitude of the Sunne or starres, observed by this staff, for any height of the ey above the water it was needfull to know the quantitie of the earths semidiameter, concerning which there is great varietie of opinions amongst learned authors: I have therefore in this part of this treatise now shewed divers waies for the more certain finding thereof; one of which waies I have also for my more assurance exemplified by observation, as meanes and opertunitie served me, neere Plimmouth sound anno 1589.

The fourth and last part may be called Astronomical, wherein my chief intent was to correct the errors that are in the ordinary Tables of declination of the Sunne, and fixed starres. To which end there is first set down a table of the declination of every minute of the Ecliptick, in degrees, minutes and seconds, calculated for the greatest obliquitie of the Zodiack as it is found by observation in this age, 23 degrees, 21 minutes and an half. Whereto is adioyned the use thereof for the readie finding of the place of the Sun by his declination given: or contrariwise for finding the Suns declination, his place being first known. After this is shewed the way and means I used for exact observation of the Suns Meridian altitudes, with a table of those observations, for four yeeres together, that so the more certaintie might be had of the declinations and places, and consequently of the whole course and motion of the Sunne: and that by comparing together so many observations, the Sunnes Eccentricitie and Apogæum might the more assuredly be known. By knowledge whereof, the way was laid open for the correcting, and true making, of the Tables of the Suns middle motions and Prosthaphæreses, which were necessarie helps and means for calculating the Ephemerides of the Sun there set down, without which the regiment or table of declination of the Sunne next following (which I may commend as free from error observable at sea, and seldome differing one minute from observation on land, and for which principally all the former pains were undertaken) could not so easily have been made. Now if any shall think that most of this fourth part going before this regiment, might have been omitted as being impertinent to the use of Mariners, and exceeding their capacitie: I answer, that it was not my purpose, neither could I in all places apply my self to the most part of sea-mens capa-

capacitie, knowing many that would not be content with this regiment alone, but that desired more to know the ground and root from whence this fruit grew: whose desire I was also willing to satisfie as I could for the present, having seldome had a more inconvenient season for such a purpose. Then after some caution given, concerning the use of this table of Declination, and the Equation thereof in places farre differing in longitude from hence, there followeth a Table of 32 principall fixed starres about the Æquinoctiall, that have been most commonly known and observed by Seamen with their Declinations corrected: and another Table of as many more of the notablest starrs about the North Pole is thereto annexed, with their distances from the Pole, corrected also and verified by diligent Observation on land. To these is added a Table of the Suns Right Ascensions (resolved into hours and minutes) for every day of the year with the use thereof for finding at what houre any of those stars commeth to the Meridian at any time of the year: that hereby the Mariner might find at all times when they come to the Meridian, and so the easilier learn to know and observe them. Hereunto I have newly adjoyned the description and use of an Instrument, which way not unfitly be called a Sea-quadrant; whereby is shewed, how the height of the Sun at sea, may by two observers, be much more exctly observed then by any other means before published: and how the height of the Pole may readily be found at any time of the night, by observation of the Pole-star and Guard, without making any abatement or allowance (as the manner hath been) in regard of the point of the compasse whereupon the Guard is situate. But now for further satisfaction in every one of these particulars, I refer the friendly Reader to the Treatise it self here following, which Simon Stevins inconsiderate desire of finding fault with my Tables of Rumbs, hath caused me to conclude with an Answer to him plainly shewing himself and not me, to be in the same fault that he would find with me.

To this Treatise (for the benefit of the younger and unskilfuller sort of Seamen) it was thought not unmeet to adjoyn the short Treatise following containing the sum of the whole Art of Navigation, first set forth in Spanish by Roderigo Samorano and since translated into English, by a friend of mine, for the benefit of our Nation: which Treatise I would wish all them that are but New beginners in that Art, first to peruse, and understand well, before they come to the reading of the former, which (for the reading thereof with the greater profit) requireth such a one as is already reasonably well acquainted with the rules and principles of

that

that Art: which I have not hitherto known to be more briefly and plainly, nor yet more fully set down and published in any other book, then they are in that little Treatise. This notwithstanding I must admonish the Reader, that in stead of the Sea-Chart therein described, according to the common error, with equal degrees of Latitude, he follow that manner of making the same, which I have in the former Treatise set down, Chap. 3, 4, 5, and 6. And that in stead of the rules and allowances for finding the Latitude by the height of the Pole-star (which are many wayes, and much erronious) he must follow the Tables adjoyned to the end of that Treatise; which for any of those eight positions of the Guards, at which Seamen use to take the height of the Pole-star, do in any Latitude truly shew the height of the Pole by the height of the Pole-star truly observed. Which Tables, together with some others in the former Treatise; as namely, that of the Declination of every minute of the Ecliptick in the 17 Chapter, together with those of the Suns Prosthaphæreses and Ephemerides in the 22 and 25 Chapters, as also that of the Suns Declination Chapter the 27: I could not by reason of my many distractions intend to make my self: but was enforced to procure my kind friend M. Henry Brigs *to undertake that labour for me: which notwithstanding (I perswade my self) many will think might well have been spared; being all undertaken upon no greater occasion then the error of one minute and a half in the Suns greatest Declination, which (by following the example of* Copernicus *and others, the chiefest Arts masters in Astronomie, in not regarding the Sunnes Parallax, when by his Solstitiall altitude, and the height of the Pole, I sought the obliquitie of the Zodiack, and distance of the Tropicks) was committed in those Tables in the former edition of my book of* Errors in Navigation.

But howsoever I may perhaps for this cause be censured by some, of too much curiositie; yet this I am sure of, that all Mariners and Sea-men, and whosoever else shall have occasion to make use of this book, have just cause to think well of my carefulnesse herein; who would have so much labour undertaken, as to have all those Tables with great diligence newly calculated throughout: rather then so small a fault as that should in this edition also passe on uncorrected. This labour therefore together with the rest, I commend to thy friendly acceptance. Farewell.

The

Certain Errors IN NAVIGATION CORRECTED.

Chap. I.

Faults in the common Sea-Chart, with Rumbes expreſſed by right lines, and degrees of Latitude, every where equall.

AS the Sea-Chart is one of the moſt principal Inſtruments that Mariners have for their direction in ſailing, ſo there is not any, wherein there are ſo great and dangerous errors.

Error in the proportion of the length and breadth of places in the common Sea-chart

1. For firſt, what places ſo ever are deſcribed therein, the length of them (from Eaſt to weſt) hath a greater proportion to the breadth (from North to South) then indeed it ought to have (except it be at the Æquinoctial.) And ſo much the more this error increaſeth, by how much the further diſtant thoſe places are from the Æquinoctial: even as the proportion of the Meridian to the Parallel, increaſeth the more, the neerer you come to either Pole; ſo that at the Parallel of 60 degr. of latitude, the proportion of the length to the breadth is twice greater

then indeed it ſhould be; and that becauſe the Meridian is double to that Parallel, and ſo in all the reſt, the proportion of the length to the breadth ſhall be greater then the truth, in the ſame proportion, wherewith the Meridian exceedeth the Parallel.

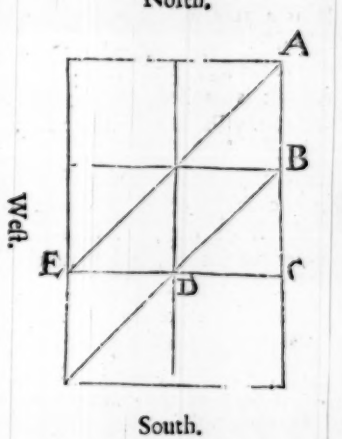
As for example: In the common Sea-Chart, the proportion of the length of *Frieſland*, to the breadth thereof, is twofold greater then in the Globe, (which ſheweth the true proportion of the length to the breadth) becauſe the Meridian is double to the parallel of that Iland. In the Ilands of Grœnland and Grocland, the length to the breadth hath a four-fold greater proportion in the comon Mariners Chart, then it hath in the Globe; becauſe the meridian is four-fold greater then the Parallel of thoſe places.

Error in finding out the difference of longitude by the common ſea Chart.

2. The way to find out the difference of longitude, by the common Sea-Chart, is true at the Æquinoctial only, and neer about the ſame may be uſed without ſenſible error: becauſe there only the Meridian and parallel are equal But on this ſide or beyond the Æquinoctial, there is error commited proportionally to the difference of the Meridian and Parallel; that is, the difference of longitude found out by the Chart, hath the ſame proportion to the true difference of longitude, that the Parallel hath to the Meridian.

As for example: At the Parallel of 60 degrees in the common Mariners Chart (wherein the degrees of the Meridians and Parallels are equal) admit B D be two places, bearing each from other South-weſt and North-eaſt, differing in latitude ſo much as is the Ark of the Meridian B C, which for example ſake we will ſuppoſe to be one degree, therefore by the ordinary Charts, the difference of Longitude C D, ſhall be likewiſe one degree: but yet in truth, becauſe the Meridian is double to that Parallel, (and conſequently, a degree of the Meridian double to a degree of that Parallel,) therefore B differing a degree in latitude from D ſhould be placed twice ſo far from C, that is at A, ſo as A B C may all be counted but for one degree of the Meridian, and ſo be equal to two degrees of the Parallel; whereof ſhould follow, that E C ſhould be the difference of longitude: that is, two degrees, (as the truth is in the Globe) whereas the common Mariners Chart ſhews the difference of longitude to be but half ſo much. And yet notwithſtanding if you go neerer to the Poles, you ſhall erre by their Chart a great deal more, even as the proportion of the Meridian to the Parallel increaſeth more and more.

But



But this error in shewing the difference of longitude, shall yet further appear by this example of *Petrus Nonius*.

In the Mariners Chart, the distance betwixt *Lisbon* and *Tercæra*, is set down to be 262 Spanish leagues. (whereof 17 and one half make a degree of the Æquinoctial, or of any of the greatest Circles) for so much the Mariners do find that distance to be, not onely by estimation of the way that the ship maketh, when they sail from East to West to that Iland, but by another account which is more certain; and that is this In sayling from *Lisbon* to *Madera*, they keep their course South-west, and from this Iland to *Tercæra*, they sayl North-west. Now because *Lisbon* and *Tercæra* have both almost the same latitude of 39 Degrees: and in sayling from North-east to South-west. and likewise from South-east to North-west, you alter the longitude as much as the latitude (because that in both those courses the angle that the way of the ship maketh with the Meridian, is equal to half a right angle: and the Iland of *Madera* hath almost 31 degrees and an half of latitude towards the North, so that the difference of the latitudes of *Lisbon* and *Madera*, as also of *Madera* and *Tercæra* is about 7 degrees and $\frac{1}{2}$.) Therefore the difference of the longitudes of *Lisbon* and *Madera*, and likewise of *Madera* and *Tercæra* shall be 7 and $\frac{1}{2}$. of the same degrees of the Meridian, both which added together make the whole difference of longitude betwixt *Lisbon* and *Tercæra*, to be 15 degrees of the Meridian, which are equal to 262, and one halfe Spanish leagues. But in the Parallel that passeth by the 39 degree of latitude, wherein (almost) *Lisbon* and *Tercæra* are placed, there are more degrees in the same space, according to that proportion wherewith the Meridian is greater then that Parallel. Therefore the true difference of longitude betwixt *Lisbon* and *Tercæra*, (that is the ar' of the Parallel or Æquinoctial contained betwixt the

Meridians of those places) shall thus be found out:

It is a rule in Geometry, that the Diameters and Peripheries, and consequently the semidiameters, and like arks of Circles have the same proportion.

Also it is manifest, that the Sine of the complement of the distance of any Parallel from the Æquinoctial, is the Semediameter of the same Parallel.

Now the distance of the Parallel of *Lisbon* and *Tercara* from the Æquinoctial is about 39 degrees, the complement whereof is 51 degrees: whose sine is 777, which is the Semidiameter of the foresaid Parallel, in such parts whereof the whole sine containeth 1000. which is the Semidiameter of the Meridan. Therefore by the rule of proportion inversed, if 262 Spanish leagues make 15 degrees in the Meridian, whose Semidiamiter is 1000 parts: then in the Parallel whose Semidiameter is 777 of the same parts, they shall make 19 degrees, and $\frac{237}{777}$ parts of one degree, that is, 18 min. and little more: which (if it be true that the course from *Lisbon* to *Madera* is South-west, and from *Madera* to *Tercara* North-west: and that the Latitude of *Madera* is 31 degrees 30 min. and the Latitude of *Lisbon* and *Tercara* 39 deg.) shall be the difference of Longitude betwixt *Lisbon* and *Tercara*. Whereas *Ortelius* and *Mercator* following (as it seemeth) the Mariners Charts without correction in their universall-Maps, make them to differ in Longitude scarce 15 degrees of their Parallel, as if it were equal to the Æquinoctial line.

Error in the lying and bearing of places one from another in the common Sea-Chart.

3. Moreover, they are deceived not only in the situation of many places, which the Marine Chart sheweth to be under the same *Meridian*: but also in the lying, or bearing of other places each from other. For the *Meridian* is a certaine rule of the positions of places. If therefore error shall be committed in the situation of the Meridian, there must needs be error in the Inclinations of the other Rumbs, points, or lines of the Compasse. And therefore not every Inclination, or respective position of place to place, which is set down in the Marine Chart, is to be taken for true: but that position or inclination only, by which some have sailed from the one place to the other. This may be seen in sayling to *India*. For the Marine Chart placeth that promontorie of *Africa*, called the promontorie of 3 points, being in Latitude towards the North, 4 degrees and one halfe, and the Ilands of *Tristan Acugna* (which have 36 degrees of Southern Latitude) under the self same *Meridian*: Also the

Marine

Marine Chart ſheweth the diſtance between theſe Ilands and the promontorie of *Good Hope*, to be almoſt 400 leagues: both which notwithſtanding cannot ſtand together. For if all the ſhore from the promontorie of 3 points unto the promontorie of *Good Hope* be rightly deſcribed, and the promontorie of 3 points alſo lie under the ſame *Meridian* with thoſe Ilands; the foreſaid diſtance muſt needs be much leſſe: but if it be not leſſe, it cannot be that they ſhould have the ſame *Meridian* with the promontorie of 3 points, but muſt needs be more to the Weſtward. Hereof it commeth, that the Mariners are very oft deceived, when they go from one place to another, following that direction which the Sea-Chart ſheweth them. Which place, when they find not by that courſe, they think that the cauſe of that error is either ſome ſwift current of the Sea, that carrieth them another way: or elſe the declination of the Poles of the Loadſtone, from the true Poles of the World: although (perchance) they erred only becauſe they knew not how thoſe places did bear one from another.

Error in ſetting of places out of the common Sea-Chart into the Globe.

4. Neither are they only deceived in that, becauſe they think that the Sea-Chart can ſhew the ſituations of all places: but alſo becauſe that when they will tranſlate the Sea coaſts out of the Chart into the Globe, they do it, having reſpect only to the numbers of the degrees of Longitude, and Latitude found therein; and no otherwiſe then when they ſet the fixed ſtars into a Cœleſtial Globe. So it commeth to paſs, that not only thoſe errors are committed, which do neceſſarily ariſe out of the common Sea-Chart: but other errors alſo which might be avoyded, if they firſt turned into degrees thoſe diſtances of Longitude which they have truly known, and then followed the Longitudes and Latitudes of places.

Error in ſhewing the diſtances of places in the common Sea-Chart.

5. In ſhewing the diſtance of places, there is as great error committed, as in any of the former. For example: If you imagine 2 ſhips to be under the *Æquinoctial* 100 leagues aſunder, and that each of them ſhould ſayl from thence due North or South under his *Meridian*, until they come to the Parallel of 60 degrees Latitude: they ſhould be there but only 50 leagues diſtant, becauſe at that Parallel the *Meridians* are diſtant but half ſo much one from another, as they were at the *Æquinoctial*; as it may moſt manifeſtly appear by the Globe: and yet the Chart will ſhew, that thoſe two ſhips have the ſelf ſame diſtance of 100 leagues, being under the parallel of 60 degrees, which they had before, when they were under the *Æquinoctial* line.

Error in keeping alwaies the same point of the Compasse.

6 There is yet another error remaining (though all the former were avoyded) which ariseth hereof, because that by the direction of the Compasse, they bend and turne the ship, in such sort, that they constrain it alwaies to make the same angles with the *Meridian*. As when they sail from *Ushent* to *Cape Raso*, both lying under the same Parallel, they guide the ship in such sort, that it maketh alwaies right angles with the *Meridian*, and so holding on their course due West, they keep themselves alwaies under the same Parallel; whereas notwithstanding, there is a more certain course, whereby they may go from one place to another without that losse of way, which they must needs make that keep themselves alwaies under the same Parallel.

There is moreover another commodity in this kind of sailing, that we may find every day by a more certain accompt what way we have made, and know in what place we are.

But this way is not to be defined by any of the lesser Circles, but by a great Circle, which is to be drawn by those two places: and the ark of that great Circle contained betwixt the same places is lesse then the ark of the Parallel which lieth between them, as may be concluded by an evident and necessary reason out of the principles of *Geometry*: much like as a straight line is shorter then a crooked, both being extended between the same pricks. Therefore this commoditie is also hereunto adjoyned, that in sailing by a great Circle, the way is more short, and compendious. But he that entreth into this course of sayling, must know, that he must often change the point of the Compasse whereupon he guideth the ship, because of the variable, and inconstant inequality of the angles, which that great Circle maketh with every new *Meridian*. Of which angles the Invention indeed (by the Chart especialy) is very subtile, and consisteth herein, to wit, in knowing how much such kind of angles do decrease or increase, as the ship goeth forwards. And he that so shapeth his course, goeth the straight and neerest way. Otherwise it cannot be that a man should keep a straight course, if he shall continually follow one and the same point, or line of the Compasse, (except he sail under a *Meridian*, or under the *Æquinoctial* line:) but he must change the point of the Compasse so often as that straight course shall sensibly require.

And therefore it cannot be by any means, that the Mariners when they go perpetualy towards the same part of the world, keeping

keeping the ſame angle of poſition in reſpect of the *Meridian*, or the ſame point of the Compaſſe, ſhould go the ſhorteſt and neareſt way.

This kind of ſayling under a great Circle, is of ſpecial uſe in our Northern Navigations, for the diſcovery of the *North-eaſt* or *North weſt paſſage*: which as it may moſt eaſily be performed by help of an Hydrographical Globe, with the Heliſphæricall lines drawn thereupon: ſo for them that liſt not to be troubled with the cumberſome carriage and charge of the Globe, it may be done (in a manner) with no leſſe facility by a nautical *Planiſphere*, made after the projection of *Gemma Friſius* his Aſtrolabe, whereof more hereafter, when God ſhall give leaſure.

The expreſſing of the Rumbs by right lines defended: which ſome hold for erroneous.

There be ſome alſo that hold it for erroneous, that the Rumbs in the Mariners Chart ſhould be expreſſed by right lines, and conſequently that the Meridians ſhould be Parallels, or equidiſtant every where; which becauſe it is but barely affirmed, and the contrary may be proved, as well as that each Rumb, except the rumb of North and South maketh equal angles with every *Meridian*: we hold it not only as true, but alſo as moſt meet and commodious for the Mariners common uſe, that the *Meridians* in the Sea-Chart ſhould be every where equidiſtant each from other and conſequently; that the Rumbs ſhould be ſtraight lines for theſe two cauſes.

Firſt, becauſe the rumbs or points of the Compaſſe may ſo moſt eaſily be drawn in the Nautical Planiſphære, onely by a ſtraight ruler. For ſeeing that any one and the ſame rumb (ſaving onely the rumb of North and South, which is all one with the *Meridian*) maketh alwaies equal angles with every *Meridian*, without either ſenſible, numerable, or meaſurable, though not without intelligible error (for indeed thoſe angles are leſſe and leſſe as they come neerer to the Pole, much like as the angle of a little ſemi-circle is leſſe then the angle of a greater ſemi-circle) all the rumbs muſt needes be ſtraight lines, if the *Meridians* be equidiſtant and right lines, by the 27 and 28 prop. 1. *Euclid.*

Secondly, the reſpective ſituation of any place to other in the Chart (which they commonly call the lying or bearing of one place from another, according to the points of the Compaſſe) may moſt eaſily be known by the Nautical Planiſphære with right lined rumbs and equidiſtant *Meridians*. For that rumb from which both places are equidiſtant ſheweth how thoſe two places lye one from another.

And

And for these two causes of so great facility, both in the making, and using of the Mariners Chart, with equidistant *Meridians*, and straight-lined rumbs, it ought to be preferred before any other Instrument heretofore published to that end, for the common use of the Mariner, at Sea especially. And though the Globe be commended by some as most absolute and perfect for all courses and Climates whatsoever: yet for the chargeableness thereof, troublesome carriage, stowage and tedious usage for the most part in Navigation, following any other course, save East or West, North or South: it will for the most part be found unmeet and cumbersome, and nothing so fit and ready for the Mariners common use at sea, as the Nauticall Planisphære truly made.

CHAP. II.

How the former Errors may be avoyded.

THese Errors notwithstanding they have been much complained of by divers, as namely by *Martine Cortese* in his third book, and second chapter of the *Art of Navigation*, but specially by *Petrus Nonius* in his second book of *Geometrical Observations, Rules, and Instruments*: And although *Gerardus Mercator* in his universal Mappe of the World seemeth to correct them, by making the distances of the parallels greater and greater towards the Poles: yet none of them teacheth any certain way how to amend such grosse faults, whereby the Mariner may be deceived many times an whole point of the Compasse, yea sometimes two or three points and more, in judging by his ordinarie Chart how one place beareth from another: especially if he sail far Northwards, or Southwards, whereby we may easily guesse, how indirect a course he shall make to come to the desired haven, that shall follow so false and erroneous direction with great danger (at the least) many times to lose ship, goods, lives, and all.

The fountain of all the errors aforesaid (the last only excepted) is in the very foundation and ground-work of the Mariners Chart, that is, in the first Geometricall lineaments thereof: namely, because the *Meridians* are not rightly divided, (the divisions being every where equall:) nor the Parallels rightly drawne (having in all places the same distances each from other that the *Meridians* have at the *Æquinoctial*:)

wherea

Whereas the ſpaces betwixt the Parallels ſhould increaſe more and more as you go from the *Æquinoctial* towards either of the Poles, which *Martin Corteſe* alſo noteth is his 3 book and 2 chapter of the *Art of Navigation*. But he omitteth that wherein all the difficultie lieth: that is, how much, or in what proportion thoſe ſpaces ſhould increaſe. Which, that it may the better be perceived, I think it not unmeet firſt to ſhew by what kind of projection (or extenſion rather) the nauticall planiſphære may not unfitly be conceived to be geometrically made, after this manner.

Suppoſe a ſphærical ſuperficies with Meridians, Parallels, Rumbes, and the whole hydrographicall deſcription drawn thereupon, to be inſcribed into a concave cylinder, their axes agreeing in one.

Let this Sphærical ſuperficies ſwel like a bladder, (whiles it is in blowing) æqually alwayes in every part thereof (that is, as much in longitude as in latitude) till it apply, and joyn it ſelf (round about, and all alongſt alſo towards either pole) unto the concave ſuperficies of the cylinder: each parallel upon this ſphærical ſuperficies increaſing ſucceſſively from the *Æquinoctial* towards either pole, until it come to be of æqual diameter with the cylinder, and conſequently the *Meridians* ſtill widening themſelves, till they come to be ſo far diſtant every where each from other as they are at the *Æquinoctial*. Thus it may moſt eaſily bee underſtood, how a ſphærical ſuperficies may (by extenſion) be made a cylindrical, and conſequently a plain Parallelogram ſuperficies; becauſe the ſuperficies of a cylinder is nothing elſe but a plain parallelogram wound about two equal equidiſtant circles that have one common axtree perpendicular upon the centers of them both, and the peripheries of each of them equal to the length of the parallelogram as the diſtance betwixt thoſe circles, or height of the cylinder is equal to the breadth thereof. So as the nauticall planiſphære may be defined to be nothing elſe but a parallellogram made of the ſphærical ſuperficies of an Hydrographical Globe inſcribed into a concave cylinder, both their axes concurring in one; and the ſphærical ſuperficies ſwelling in every part equally in longitude and latitude, till every one of the Parallels thereupon be inſcribed into the cylinder (each parallel growing as great as the *Æquinoctial*:) or till the whole ſphærical ſuperficies, touch and apply it ſelfe every where to the concavity of the cylinder.

The definition of the *Nautical Planiſphare*.

In this nauticall planiſphære thus conceived to be made, all

places must needs be situate in the same longitudes, latitudes, and directions or courses, and upon the same Meridians, Parallels, and Rumbes, that they were in the Globe, because that at every point between the *Æquinoctial* and the *Pole*, we understand the Spherical superficies whereof this Plani-sphere is conceived to be made, to swell equally as much in longitude as in latitude (til it joyn it self unto the concavity of the cylinder, so as hereby no part thereof is any way distorted or displaced out of his true and natural situation upon his Meridian, Parallel, or Rumbe, but only dilated and enlarged: the Meridians also, Parallels, and Rumbes dilating and enlarging themselves likewise, at every point of latitude in the same proportion.

Now then let us diligently consider of the Geometrical lineaments, that is, the Meridians, Rumbs, and Parallels of this imaginary nautical Planisphere, that we may in like manner expresse the same in the Mariners Chart. For so undoubtedly we shall have therein a true hydrographical description of all places, in their longitudes, latitudes, and directions, or respective situations each from other according to the points of the Compasse in all things correspondent to the Globe, without either sensible, or explicable error.

First therefore in this planisphær. because the Parallels are every where equal each to other (for every one of them is equal to the *Æquinoctial* or circumference of the circumscribing cylinder) the *Meridians* also must needs be Parallel and streight lines: and consequently the rumbs (making equal angles with every *Meridian*) must likewise be streight lines.

27 Prop. 1. *Euclid* 17.

Secondly, because the Spherical superficies whereof this Planisphære is conceived to be made, swelleth in every part thereof equally, that is, as much in latitude, as in longitude till it apply it self round about, to the concavity of the cylinder: therefore at every point of latitude in this planisphære, a part of the *Meridian* keepeth the same proportion to the like part of the parallel, that the like parts of the *Meridian*, and Parallel have each to other in the Globe, without any explicable error.

Now because like parts of wholes keep the same proportion that their wholes have, therefore the like parts of any Parallel and Meridian of the Globe, have the same proportion that the same Parallel and Meridian have.

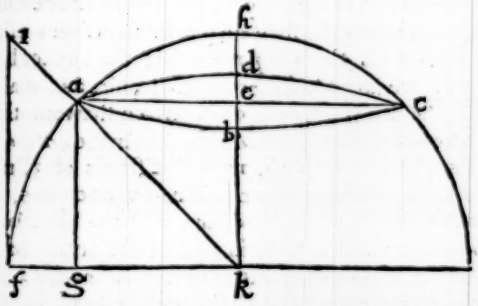
For example sake, as the Meridian is double to the Parallel of 60 degrees, so a degree of the Meridian is double to a degree of that

that Parallel, or a minute to a minute, &c. and what proportion the Parallel hath to the Meridian, the ſame proportion have their diameters and ſemidiameters each to other, 26. 18. *c.* 2, *c.* 15. *Ram.*

But the ſine of the complement of the Parallels latitude, or diſtance from the *Æquinoct.* is the Semidiameter of the Parallel;

As here you ſee, *a e* the ſine of *a h* the complement of *a f* the latitude or diſtance of the Parallel *a b c d*, from the *Æquinoctial*, is the Semidiameter of the ſame Parallel *a b c d*.

And as the Semidiameter of the Meridian (or the whole ſine) is to the Semidiameter of the Parallel, ſo is the Secans, or Hypotenuſa of the Parallels latitude (or of the Parallels diſtance from the *Æquinoctial*) to the Semidiameter of the Meridian, or to the whole ſine; as *f k*, (that is) *a k*, to *a e* (that is) *g k*; ſo is *i k*, to *k f*.



Therefore in this nautical planiſphære, the Semidiameter of each Parallel being equal to the Semidiameter of the *Æquinoctial* (that is) to the whole ſine; the parts of the Meridian at every point of latitude muſt needs increaſe with the ſame proportion wherewith the Secants of the ark, conteined between thoſe points of latitude and the *Æquinoctial* do increaſe.

Now then we have an eaſie way laid open for the making of a table (by help of the Canon of Triangles) whereby the Meridians of the Mariners Chart may moſt eaſily and truly be divided into parts, in due proportion from the *Æquinoctial* towards either Pole.

For (ſuppoſing each diſtance of each point of latitude, or of each Parallel from other, to contein ſo many parts as the Secans of the latitude of each point or Parallel conteineth) by perpetual addition of the Secantes anſwerable to the latitudes of each point or Parallel unto the ſum compounded of all the former

secantes, beginning with the secans of the first Parallels latitude, and thereto adding the secans of the second Parallels latitude, and to the sum of both these adjoyning the secans of the third Parallels latitude, and so forth in all the rest, we may make a table which shall truly shew the sections and points of latitude in the Meridians of the nautical planisphære: by which sections, the Parallels are to be drawn.

As in the table following, we make the distance of each Parallel from other, to be one minute: and we suppose the space between any two Parallels each next to other in the planisphære to contein so many parts as the secans answerable to the distance of the furthest of those two Parallels from the *Æquinoctial*, and so by perpetual addition of the secans of each minute to the sum compounded of all the former secants, I make the whole table. As for example, the secans of one minute is 10, 000, 000. which also sheweth the section of one minute of the Meridian from the *Æquinoctial* in the nauticall planisphære. Whereunto adde the secans of 2. minutes, that is 10, 000, 002, the sum is 20, 000, 002. which sheweth the section of the second minute of the Meridian from the *Æquinoctial*, in the planisphære: to this sum adde the secans of 3. minutes, which is 10, 000, 004, the sum will be 30, 000. 006, which sheweth the section of the third minute of the Meridian from the *Æquinoctial*: and so forth in all the rest: saving that in this table we have of purpose omitted in every secans the 3 first ciphers next the right hand: not only for the easier, but also for the truer making of the table, because that indeed, at every point of latitude, a minute of the Meridian in this nautical planisphære, hath somewhat lesse proportion to a minute of the Parallel adjoyning towards the *Æquinoctial*, then the secans of that Parallels latitude hath to the whole sine. But in this table it was thought sufficient to use such exactnes as that thereby (in drawing the lineaments of the nautical planisphære) sensible error might be avoided. He that listeth to be more precise may make the like table to decades or tennes of seconds. our of *Ioachimus Rhæticus* his *Canon magnus triangulorum*. Notwithstanding the *Geometrician* that desireth exact truth, cannot be so satisfied neither: for whose sake and further satisfaction, I thought good to adjoyn also this Geometrical conceit of dividing a Meridian of the nautical planisphære.

Let the *Æquinoctial* and a Meridian be drawn upon a Globe: Let the Meridian (divided into degrees, minutes, seconds, &c.)

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roul upon a ſtreight line beginning at the *Æquinoctial*, the Globe ſwelling in the mean time in ſuch ſort that the Semidiameter thereof may be alwaies equal to the ſecans of the angle, or arch conteined between the *Æquinoctial* and Semediameter inſiſting at right angles upon the foreſaid ſtreight line: The degrees, minutes, ſeconds, &c. of the Meridian, noted in the ſtreight line, as they come to touch the ſame, are the diviſions of the Meridian in the nautical planiſphære. And this conceit of dividing the Meridian of the nautical planiſphære may ſatisfie the curious exactneſs of the Geometritian: but for mechanical uſe, the table before mentioned (which here now followeth) may ſuffice.

This Table (ſerving principally for the true dividing of the Meridians of the Sea Chart, in ſuch ſort that in any part thereof, a minute of the Meridian ſhall have the ſame proportion to a minute of the Parallel thereto adjoyning that it hath in the Globe) may not unfitly be called, *A Table of Latitudes.*

For as in Geographie, the latitude of a place is nothing elſe but the ſhorteſt diſtance thereof from the *Æquinoctial* line, meaſured upon the convexitie of the earth or ſea in degrees and minutes; and therefore Tables containing ſuch diſtances are ordinarily called *Tables of Latitudes*: So this Table, ſhewing the diſtance of every minute of a Meridian in the Sea Chart from the *Æquinoctial* line thereof towards the North or South, in ſuch equal parts whereof one minute of the *Æquinoctial* is ſuppoſed to contain 10,000, may with like reaſon, by a certain analogie and reſemblance it holdeth with the foreſaid tables, be very well called, *A Table of Latitudes of every minute of a Meridian of the Sea Chart, in ſuch parts whereof each minute of the* Æquinoctial *containeth* 10, 000.

This Table is divided into three columnes; whereof the firſt containeth, in the head thereof the degrees, and in the reſt of that columne, minutes of a Meridian of the nautical planiſphær, beginning at the *Æquinoctial* line. In the ſecond columne are placed equal parts of the ſame Meridian, beginning likewiſe to be numbred from the *Æquinoctial* (of which parts each minute of the *Æquinoctial* is ſuppoſed to contain 10, 000) and ſheweth how many of theſe parts each minute of latitude in the Sea Chart muſt be diſtant from the *Æquinoctial*. The third columne ſheweth the differences of the numbers ſet down in the ſecond columne.

The uſe hereof followeth after this Table.

Min.	0 Degr. Equal parts of a Merid.	Difference of equ. par.	1 Degr. Equal parts of a Merid.	Difference of equ. par.	2 Degr. Equal parts of a Merid.	Difference of equ. par.	3 Degr. Equal parts of a Merid.	Difference of equ. par.
0	00.000	10.000	600.012	10.001	1.200.196	10.006	1.800.749	10.013
1	10.000	10.000	610.013	10.001	1.210.202	10.006	1.810.762	10.014
2	20.000	10.000	620.014	10.001	1.220.208	10.006	1.820.776	10.014
3	30.000	10.000	630.015	10.001	1.230.214	10.006	1.830.790	10.014
4	40.000	10.000	640.016	10.001	1.240.220	10.006	1.840.804	10.014
5	50.000	10.000	650.017	10.001	1.250.226	10.006	1.850.818	10.014
6	60.000	10.000	660.018	10.001	1.260.232	10.006	1.860.832	10.014
7	70.000	10.000	670.019	10.001	1.270.238	10.006	1.870.846	10.014
8	80.000	10.000	680.020	10.002	1.280.244	10.007	1.880.860	10.015
9	90.000	10.000	690.022	10.002	1.290.251	10.007	1.890.875	10.015
10	100.000	10.000	700.024	10.002	1.300.258	10.007	1.900.890	10.015
11	110.000	10.000	710.026	10.002	1.310.265	10.007	1.910.905	10.015
12	120.000	10.000	720.028	10.002	1.320.272	10.007	1.920.920	10.015
13	130.000	10.000	730.030	10.002	1.330.279	10.007	1.930.935	10.015
14	140.000	10.000	740.032	10.002	1.340.286	10.007	1.940.950	10.016
15	150.000	10.000	750.034	10.002	1.350.293	10.007	1.950.966	10.016
16	160.000	10.000	760.036	10.002	1.360.300	10.007	1.960.982	10.016
17	170.000	10.000	770.038	10.002	1.370.307	10.008	1.970.998	10.016
18	180.000	10.000	780.040	10.002	1.380.315	10.008	1.981.014	10.016
19	190.000	10.000	790.042	10.002	1.390.323	10.008	1.991.030	10.016
20	200.000	10.000	800.044	10.002	1.400.331	10.008	2.001.046	10.017
21	210.000	10.000	810.046	10.002	1.410.339	10.008	2.011.063	10.017
22	220.000	10.000	820.048	10.002	1.420.347	10.008	2.021.080	10.017
23	230.000	10.000	830.050	10.002	1.430.355	10.008	2.031.097	10.017
24	240.000	10.000	840.052	10.003	1.440.363	10.008	2.041.114	10.017
25	250.000	10.000	850.055	10.003	1.450.371	10.009	2.051.131	10.017
26	260.000	10.000	860.058	10.003	1.460.380	10.009	2.061.148	10.018
27	270.000	10.000	870.061	10.003	1.470.389	10.009	2.071.166	10.018
28	280.000	10.000	880.064	10.003	1.480.398	10.009	2.081.184	10.018
29	290.000	10.000	890.067	10.003	1.490.407	10.009	2.091.201	10.018
30	300.000	10.000	900.070	10.003	1.500.416	10.009	2.101.220	10.018
31	310.000	10.000	910.073	10.003	1.510.425	10.009	2.111.238	10.019
32	320.000	10.000	920.076	10.003	1.520.434	10.009	2.121.257	10.019
33	330.000	10.000	930.079	10.003	1.530.443	10.010	2.131.276	10.019
34	340.000	10.000	940.082	10.003	1.540.453	10.010	2.141.295	10.019
35	350.000	10.000	950.085	10.003	1.550.463	10.010	2.151.314	10.019
36	360.000	10.000	960.088	10.003	1.560.473	10.010	2.161.333	10.019
37	370.000	10.000	970.091	10.004	1.570.483	10.010	2.171.352	10.020
38	380.000	10.000	980.095	10.004	1.580.493	10.010	2.181.372	10.020
39	390.000	10.000	990.099	10.004	1.590.503	10.010	2.191.392	10.020
40	400.000	10.000	1.000.103	10.004	1.600.513	10.010	2.201.412	10.020
41	410.000	10.000	1.010.107	10.004	1.610.523	10.011	2.211.432	10.021
42	420.000	10.000	1.020.111	10.004	1.620.534	10.011	2.221.452	10.021
43	430.000	10.000	1.030.115	10.004	1.630.545	10.011	2.231.473	10.021
44	440.000	10.000	1.040.119	10.004	1.640.556	10.011	2.241.494	10.021
45	450.000	10.000	1.050.123	10.004	1.650.567	10.011	2.251.515	12.021
46	460.000	10.000	1.060.127	10.004	1.660.578	10.011	2.261 536	12.021
47	470.000	10.000	1.070.131	10.004	1.670.589	10.011	2.271.557	11.003
48	480.000	10.001	1.080.135	10.005	1.680.600	10.012	2.281.579	10.022
49	490.000	10.001	1.090.140	10.005	1.690.612	10.012	2.291.601	10.022
50	500.000	10.001	1.100.145	10.005	1.700.624	10.012	2.301.622	10.022
51	510.000	10.001	1.110.150	10.005	1.710.636	10.012	2.311.645	10.022
52	520.000	10.001	1.120.155	10.005	1.720.648	10.012	2.321.667	10.023
53	530.000	10.001	1.130.160	10.005	1.730.660	10.012	2.331.690	10.023
54	540.000	10.001	1.140.165	10.005	1.740.672	10.012	2.341.712	10.023
55	550.000	10.001	1.150.170	10.005	1.750.684	10.013	2.351.736	10.023
56	560.000	10.001	1.160.175	10.005	1.760.697	10.013	2.361.759	10.023
57	570.000	10.001	1.170.180	10.005	1.770.710	10.013	2.371.782	10.024
58	580.000	10.001	1.180.185	10.005	1.780.723	10.013	2.381.806	10.024
59	590.000	10.001	1.190.190	10.006	1.790.736	10.013	2.391.830	10.024

Min.	4 Degr. Equal parts of a Merid.	Difference of equ par.	5 Degr. Equal parts of a Merid	Difference of equ. par.	6 Degr. Equal parts of a Merid.	Difference of equ. par.	7 Degr. Equal parts of a Merid.	Difference of equ. par.
0	2.401.854	10.024	3.003.694	10.038	3.606.455	10.055	4.210 328	10.075
1	2.411.878	10.024	3.013.732	10.038	3.616. 510	10 055	4 220.403	10.075
2	2.421. 902	10.025	3.023.770	10.038	3.626. 565	10.056	4.230.478	10 076
3	2.431.927	10.025	3.033.808	10.039	3.636.621	10 056	4.240 554	10.076
4	2.441.952	10.025	3.043.847	10 039	3 646.677	10.056	4.250 630	10.076
5	2.451.977	10.025	3.053.886	10 039	3.656.733	10.056	4.260.706	10.077
6	2.462.002	10.025	3.063.925	10.040	3.666.789	10.057	4.270 783	10.077
7	2.472.027	10.026	3.073.965	10 040	3.676.846	10.057	4 280.860	10.078
8	2.482.053	10.026	3.084.005	10 040	3 686.903	10.057	4.290.938	10.078
9	2.492.079	10.026	3.094.045	10.040	3.696.960	10.058	4.301.016	10.078
10	2.502.105	10.026	3.104.085	10.041	3.707.018	10 058	4.311 094	10 079
11	2.512.131	10.026	3.114.126	10.041	3.717.076	10.058	4.321.173	10 079
12	2.522.157	10.027	3 124.167	10 041	2.727 134	10 059	4.331.252	10.079
13	2.532.184	10.027	3.134 208	10.041	3.737.193	10.059	4.341.331	10.080
14	2.542.211	10.027	3.144 249	10.042	3.747.252	10.059	4 351.411	10.080
15	2.552.238	10.027	3.154.291	10 042	3.757.311	10.060	4.361.491	10.080
16	2.562.265	10.028	3.164 333	10.052	3.767.371	10 060	4.371.571	10.081
17	2.572.293	10.028	3.174.375	10 042	3 777.431	10.060	4.381.652	10.081
18	2.582.321	10.028	3.184 417	10.043	3.787.491	10 061	4.391.733	10.082
19	2.592.349	10.028	3.194.460	10.043	3 797.552	10 061	4.401.815	10.082
20	2.602.377	10.028	3.204 503	10.043	3.807.613	10.061	4.411 897	10.082
21	2.612.405	10.029	3.214.546	10 044	3.817.674	10.062	4 421.979	10.083
22	2.622.434	10.029	3.224 593	10 044	3.827 736	10 062	4.432.062	10.083
23	2.632.463	10.029	3.234.634	10 044	3.837.798	10 062	4.442 145	10.083
24	2.642. 492	10.029	3 244.678	10 044	3.847.860	10.063	4.452.228	10.084
25	2.652.521	10.039	3.254.722	10.045	3.857 923	10.063	4.462.312	10.084
26	2.662.551	10.030	3.264.767	10.045	3.867.986	10.063	4.472.396	10.085
27	2.672.581	10.030	3.274.812	10.045	3.878.049	10.064	4.482.481	10.085
28	2.682.611	10.030	3.284.857	10 045	3.888.113	10.064	4.492.566	10.085
29	2.692.641	10.030	3.294 902	10.046	3.898.177	10.064	4.502.651	10.086
30	2.702.671	10.031	3.304.948	10 046	3.908.241	10.065	4.512.737	10.086
31	2.712.702	10.031	3.314.994	10 046	3 918.306	10.065	4.522.823	10 087
32	2.722.733	10.031	3 325.040	10.047	3.928.371	10 065	4.532.910	10.087
33	2.732.764	10.031	3.335.087	10.047	3.938.436	10.066	4.542.997	10.087
34	2.742.795	10.032	3.345.134	10.047	3.948.502	10.066	4.553.084	10.088
35	2.752.827	10.032	3.355 181	10.047	3.958.568	10.066	4.563.172	10.088
36	2.762.859	10.032	3.365 228	10 048	3.968.934	10.067	4.573.260	10.089
37	2.772.891	10.032	3 375.276	10.048	3.978.701	10 067	4.583.349	10 089
38	2.782.923	10.033	3.385.324	10.048	3 988.768	10.067	4.543 438	10 090
39	2.792.956	10.033	3 395 372	10 049	3.998.835	10.068	4.603.527	10.090
40	2.802.989	10.033	3.405.421	10.049	4.008.903	10.068	4.613.617	10 090
41	2.813.022	10.033	3.415.470	10 049	4.018.971	10.068	4.623.707	10.090
42	2.823.055	10.033	3.425.519	10.049	4.029 039	10.069	4 633 797	10 091
43	2.833.088	10.034	3.435.568	10.050	4.039.108	10.069	4.643.888	10.091
44	2.843.122	10.034	3.445 618	10.050	4.049.177	10.069	4 653.979	10 092
45	2.853.156	10.034	3.455.668	10 050	4 059.246	10 070	4 664.071	10 092
46	2.863.190	10.034	3.465.718	10.051	4.069.316	10.070	4.674.136	10.092
47	2.873.224	10.035	3.475.769	10 051	4 079.386	10 070	4 684 228	10 093
48	2.883.259	10.035	3.485 820	10.051	4.089 456	10.071	4 694.321	10.093
49	2.893.294	10.035	3 495.871	10 052	4.099.527	10.071	4.704 414	10.094
50	2.903.329	10.035	3.505.923	10.052	4.109.598	10.071	4.714 508	10 094
51	2.913.364	10.036	3.515 975	10 052	4.119.669	10 072	4.724 602	10 095
52	2.923.300	10.036	3.526 027	10.052	4.129.741	10 072	4 734.697	10.095
53	2.933.436	10.036	3.536.079	10.053	4.139.813	10.072	4.744.792	10 095
54	2.943.472	10.036	3.546.132	10.053	4.149.885	10 073	4.754.887	10 096
55	2.953.508	10.037	3.556.185	10 053	4 159 958	10.073	4.764.983	10.096
56	2.963.545	10.037	3.566.238	10.054	4 170.031	10 074	4.775 070	10.097
57	2.973.582	10.037	3.576.292	10.054	4.180.105	10.074	4.785.176	10 097
58	2.983.619	10.037	3.586.346	10.054	4 190.179	10.074	4.795.273	10 097
59	2.993.656	10.038	3.596.400	10 055	4.200.253	10.075	4.805 370	10.098

Min.	8 Degr. Equal parts of a Merid.	Difference of equ. par	9 Degr. Equal parts of a Merid.	Difference of equ. par.	10 Degr. Equal parts of a Merid.	Difference of equ. par.	11 Degr. Equal parts of a Merid.	Difference of equ. par.
0	4·815·468	10·098	5·422·133	10·125	6 030·475	10 154	6·640·679	10·187
1	4·825 566	10 099	5·432·258	10 125	6·040·629	10 155	6·650·866	10·188
2	4·835·665	10·099	5·442·383	10·126	6·050·784	10 155	6·661·054	10·188
3	4·845·764	10·099	5·452 509	10·126	6 060 939	10 156	6·671 242	10 189
4	4·855·863	10·100	5·462·635	10·126	6 071 098	10 156	6·681·431	10·190
5	4·865·963	10·100	5·472·761	10·127	6 081·251	10·157	6·691·621	10·190
6	4·876 063	10·101	5·482·888	10·127	6·091·408	10 157	6·701·811	10 191
7	4·886·164	10·101	5·493·015	10·128	6·101·565	10·158	6·712·002	10·191
8	4·896·265	10·102	5·503·143	10·128	6·111·723	10 158	6·722·219	10·192
9	4·906·367	10·102	5·513 271	10·129	6·121·881	10 159	6·732·385	10·192
10	4·916·469	10·102	5·523·400	10·129	6·132·040	10 160	6 742·577	10 193
11	4·926·571	10·103	5·533·529	10·130	6 142 200	10·160	6·752 770	10·194
12	4 936 674	10·103	5·543·659	10·130	6·152·360	10 161	6 762·964	10·194
13	4·946·777	10·104	5·553·789	10·131	6·162·521	10·161	6 773·158	10·195
14	4·956·881	10·104	5·563 920	10 131	6 172·682	10·162	6 783·353	10·195
15	4·966·985	10·104	5·574·051	10·132	6·182 844	10·162	6·793·548	10·196
16	4·977·089	10·105	5·584·183	10·132	6·193 006	30·163	6·803 744	10·197
17	4·987 194	10·105	5·594 315	10·133	6·203·169	10·163	6·813·941	10·197
18	4·997·299	10·106	5·604·448	10·133	6 213·332	10·164	6·824·138	10·198
19	5·007·405	10·106	5·614·581	10 134	6 223·496	10 165	6·834 336	10·198
20	5·017·511	10·107	5·624·715	10 134	6·233·661	10 165	6 844·534	10·199
21	5·027·618	10 107	5·634·849	10·135	6·243·826	10 165	6·854 733	10·200
22	5·037·725	10 108	5·644·984	10·135	6 253 991	10·166	6·864 933	10 200
23	5·047·833	10·108	5 655·119	10·136	6·264·157	10·167	6·875·133	10·201
24	5 057·941	10 108	5·665·255	10·136	6·274 324	10 167	6·885·334	10 201
25	5·068·049	10·109	5·675·391	10·137	6·284 491	10·168	6·895·535	10 202
26	5·078·158	10·109	5 685·528	10·137	6 294·659	10·168	6·905·737	10·203
27	5·088·267	10·110	5·695·665	10·138	6·304 827	10·169	6·915 940	10 203
28	5·098 377	10·110	5·705·803	10·138	6·314 996	10 169	6·926·143	10·204
29	5·108·487	10·111	5 715 941	10·139	6·325·165	10·170	6 936·347	10·204
30	5·118·598	10·111	5·726·080	10·139	6·335·335	10·170	6·946·551	10·205
31	5·128·709	10·111	5 736·219	10·140	6 345·505	10 171	6 956·756	10·206
32	5 138·820	10 112	5·746·359	10·140	6·355 676	10·171	6 966·962	10 206
33	5·148·932	10·112	5·756·499	10·141	6·365·847	10 172	6·977·168	10·207
34	5·159·044	10·113	5·766 640	10·141	6·379 019	10·173	6·987·375	10·207
35	5·169 157	10·113	5·776·781	10·142	6·386·192	10 173	6·997·582	10·208
30	5·179 270	10·114	5 786·922	10·142	6·396·365	10·174	7 007 790	10 209
37	5·189·384	10·114	5·797 065	10·143	6·406 539	10 174	7·017·999	10·209
38	5·199·498	10·115	5·807·208	10·143	6·416·713	10 175	7·028 208	10 210
39	5·209·613	10 115	5·817·351	10·144	6 426·888	10 175	7·038 418	10·210
40	5·219·728	10 115	5·827 495	10·144	6·437·063	10 176	7·048 628	10 211
41	5·229·843	10·116	5·837·639	10 145	6·447·239	10 176	7·058·839	10 212
42	5·239·959	10·116	5·847 784	10·145	6·457·415	10·177	7 069·051	10·212
43	5·250·075	10·117	5·857·929	10·146	6·467·592	10 178	7·079·263	10 213
44	5·260·193	10·117	5·868·075	10·146	6 477 770	10 178	7 089 476	10 214
45	5·270 309	10·118	5·878·221	10·147	6·487·948	10 179	7·099·690	10 214
46	5·280 427	10·118	5·888·368	10·147	6·498 127	10·179	7·109 904	10 215
47	5·290·545	10·119	5·898·515	10·148	6·508·306	10 180	7·120 119	10 215
48	5·300·664	10·119	5·908·663	10·148	6 518·486	10·180	7 130 334	10·216
49	5·310·782	10 120	5·918·811	10 149	6·528 666	10·181	7·140 550	10 217
50	5·320·903	10·120	5 928·960	10·149	6·538·847	10·182	7 150 767	10 217
51	5·331·023	10·120	5 939·109	10·150	6·549·029	10·182	7·160 984	10 218
52	5·341 143	10·121	5·949 259	10·150	6·559·211	10·183	7·171·202	10 219
53	5·351·264	10·121	5 959·409	10·151	6·569 394	10 183	7 181 421	10 219
54	5·361·385	10·122	5 969 560	10·151	6·579·577	10·184	7 191·640	10·220
55	5 371·507	10·122	5 979·711	10·152	6 589·761	10 184	7·201·860	10·220
56	5·381·629	10·122	5·989 863	10 152	6·599·945	10·185	7·212 080	10 221
57	5 391·752	10·123	6 000·015	10 153	6·610 130	10·186	7·222·301	10 222
58	5·401·875	10·124	6·010·168	10·153	6·620·316	10 186	7·232·523	10·222
59	5·411 999	10·124	6·020·321	10·154	6 630 502	10 187	7·242·745	10·220

Degr.	12 Degr. Equal parts of a Merid	Difference of equ par.	13 Degr. Equal parts of a Merid.	Difference of equ. par.	14 Degr. Equal parts of a Merid.	Difference of equ. par.	15 Degr Equal parts of a Merid.	Difference of equ. par.
0	7·252·968	10·224	7 867·534	10·263	8·484 584	10·306	9·104·325	10·353
1	7 263·192	10 224	7·877·797	10·264	8·494·890	10·307	9 114·678	10·353
2	7·273·416	10·225	7·888 061	10·265	8 505·197	10·308	9·125·032	10·354
3	7·283·641	10·225	7 898·326	10 265	8·515·505	10·309	9·135·387	10·355
4	7 293·866	10·226	7·908 591	10·266	8 525·814	10·309	9·145·742	10 355
5	7 304·092	10·227	7·918·857	10·267	8·536·123	10·310	9·156·098	10·356
6	7·314·319	10·227	7·929·124	10·267	8·546·433	10·311	9·166·455	10 357
7	7·324·546	10 228	7·939·391	10·268	8·556·744	10·312	9·176·813	10 358
8	7·334 774	10·229	7·949·659	10 269	8·567·056	10·312	9·187·172	10·359
9	7·345 003	10·229	7·959·928	10·269	8·577·368	10 313	9·197·532	10 360
10	7·355 232	10 230	7 970·197	10·270	8·587·681	10·314	9·207·892	10·360
11	7·365·462	10·231	7·980·467	10·271	8·597·995	10·315	9·218·253	10·361
12	7·375 693	10·231	7·990·738	10·272	8·608 310	10·315	9·228·615	10·362
13	7·385·924	10·232	8·001 010	10·272	8·618·625	10 316	9·238·978	10·363
14	7·396·156	10·232	8·011·282	10·273	8·628·941	10·317	9·249·342	10 364
15	7·406·388	10·233	8·021·555	10·274	8 639·258	10·318	9·259·706	10·364
16	7·416·621	10·234	8·031·829	10·274	8 649·576	10·318	9·270 071	10 365
17	7·426·855	10·234	8·042 103	10·275	8·659·894	10·319	9·280 437	10·366
18	7·437·089	10·235	8·052·378	10·276	8 670·213	10·320	9·290·804	10·367
19	7·447·324	10·236	8·062·654	10·277	8·680·533	10·321	9·301·172	10·368
20	7·457·560	10·236	8·072·931	10·277	8·690·854	10·322	9·311·541	10·369
21	7·467·796	10·237	8·083·208	10·278	8·701·176	10·322	9·321·910	10·369
22	7·478·033	10·238	8·093·486	10·279	8·711·498	10·323	9·332·280	10·370
23	7·488·271	10·238	8·103·765	10·279	8·721 821	10·324	9·342·651	10·371
24	7·498·509	10·239	8·114·044	10·280	8·732·145	10·325	9·353·023	10·372
25	7·508·748	10·240	8·124·324	10·281	8 742·470	10·325	9·363·396	10·373
26	7·518·988	10·240	8·134·605	10·282	8,752·795	10·326	9·373·770	10·374
27	7·529·228	10·241	8·144·887	10·282	8·763·121	10·327	9·384·144	10 374
28	7·539·469	10·242	8·155·169	10·283	8·773·448	10·328	9·394·519	10·375
29	7·549 711	10·242	8·165·452	10·284	8·783·776	10·329	9·404·895	10·376
30	7·559·953	10·243	8·175·736	10·284	8·794·105	10·329	9·415·272	10·377
31	7·570·196	10·244	8·186·020	10·285	8·804·434	10·330	9·425·650	10·378
32	7·580·440	10·244	8·196 305	10·286	8·814·764	10·331	9·436 029	10 379
33	7·590·684	10·245	8·206·591	10·287	8·825·095	10·332	9·446·408	10·379
34	7·600·929	10·246	8·216·878	10·287	8·835·427	10·332	9·456·788	10·380
35	7·611·175	10·246	8·227·169	10·288	8·845·759	10·333	9·467 169	10·381
36	7·621·421	10·247	8·237·453	10·289	8·856·092	10 334	9·477·551	10·382
37	7·631·668	10·248	8·247·742	10·289	8·866·426	10·335	9·487·934	10 383
38	7·641·916	10·248	8 258·031	10·290	8·876·761	10·336	9·498·318	10·384
39	7·652 164	10·249	8·268·321	10·291	8·887·097	10·336	9·508·702	10·384
40	7·662·413	10·250	8·278·612	10·292	8 897·433	10·337	9·519·087	10 385
41	7·672·663	10·250	8·288·904	10·292	8·907·770	10·338	9·529·473	10·386
42	7·682·913	10 251	8·299·196	10·293	8·918·108	10 339	9·539 860	10·387
43	7·693·164	10·252	8·309·489	10·294	8·928·447	10·339	9·550·248	10·388
44	7·703·416	10·252	8·319·783	10·295	8 938·786	10·340	9 560·637	10·389
45	7·713·668	10·253	8·330·078	10·295	8·949·126	10·341	9·571·027	10·390
46	7·723·921	10·254	8·340·373	10·296	8·959·467	10·342	9·581·417	10·390
47	7·734·175	10·254	8·350·669	10·297	8·969·809	10·343	9·591·808	10·391
48	7 744·429	10·255	8·360·966	10·297	8·980·152	10·343	9·602 200	10·392
49	7·754·684	10·256	8 371·263	10·298	8·990·495	10·344	9·612·593	10·393
50	7·764·940	10·256	8·381·561	10·299	9 000·839	10·345	9·622·987	10·394
51	7·775·196	10·257	8·391·860	10·300	9·011·184	10·346	9·633·382	10·395
52	7·785·453	10·258	8·402·160	10 300	9 021·530	10·347	9 643·778	10·396
53	7·795·711	10·258	8·412·460	10·301	9·031·877	10·347	9·654·174	10·396
54	7 805·969	10·259	8·422·761	10·302	9·042·224	10·348	9·664 571	10·397
55	7·816·228	10·260	8·433·063	10·303	9 052·572	10·349	9·674·969	10·398
56	7·826·488	10·260	8·443·366	10·303	9·062·921	10·350	9·685·368	10 399
57	7·836·748	10·261	8·453·669	10·304	9 073·271	10·351	9·695·768	10 400
58	7·847·009	10 262	8·463·973	10·305	9·083·622	10·351	9·706·169	10·401
59	7·857·271	10·263	8·474·278	10·306	9·093·973	10·352	9·716·571	10·402

Min.	16 Degr. Equal parts of a Merid.	Difference of equ. par.	17 Degr. Equal parts of a Merid.	Difference of equ. par.	18 Degr. Equal parts of a Merid.	Difference of equ. par.	19 Degr. Equal parts of a merid.	Difference of equ. par.
0	9 726.973		10.352.748		10.981.870		11.614.570	
		10.403		10.457		10.515		10.577
1	9.737.376		10.363.205		10.992.383		11.625.147	
		10.404		10.458		10.516		10.578
2	9.747.780		10.373 665		11.002.899		11.635.725	
		10.405		10 459		10.517		10.579
3	9.758.185		10.384.122		11.013.416		11.646.304	
		10 406		10.460		10.518		10.580
4	9.768.591		10.394.582		11.023.934		21.656.884	
		10 407		10.461		10.519		10.581
5	9.778.998		10.405 043		11.034.453		11.667.465	
		10 408		10.462		10.520		10.582
6	9 789.406		10.415 505		11.044.973		11.678.047	
		10 409		10.463		10 521		10.583
7	9 799 815		10.425.968		11.055.494		11.688.630	
		10.409		10.464		10.522		10.584
8	9.810.224		10.436.432		11.066.016		11.699.214	
		10.410		10 465		10.523		10.585
9	9.820.634		10.446.897		11.076.539		11.709.799	
		10 411		10.466		10.524		10.586
10	9.831.045		10 457.363		11.087.063		11.720.385	
		10.412		10 467		10.525		10 587
11	9.841.457		10.467.830		11.097.588		11 730.972	
		10.413		10 468		10.526		10.588
12	9.851.870		10.478 298		11.108.114		11.741.560	
		10.414		10.469		10.527		10.590
13	9.862.284		10.488.767		11.118.641		11.752.150	
		10.415		10.470		10.528		10.591
14	9.872.699		10 499.237		11 129.169		11.762.741	
		10.416		10.470		10.529		10.592
15	9.883.115		10.509.707		11.139.698		11.773.333	
		10.417		10.471		10.530		10.593
16	9.893.532		10 520.178		11.150.228		11.783.926	
		10.417		10.472		10.531		10.594
17	9.903.949		10.530.650		11.160.759		11.794.520	
		10.418		10.473		10.532		10.595
18	9.914.367		10.541.123		11.171.291		11.805.115	
		10.419		10.474		10.533		10.596
19	9.924.786		10 551.597		11.181.824		11.815.711	
		10.420		10.475		10.534		10.597
20	9.935 206		10.562 072		11.192.358		11 826.308	
		10.421		10.476		10.535		10.598
21	9.945.627		10.572 548		11.202.893		11.836.906	
		10.422		10.477		10.536		10.599
22	9.956.049		10.583.025		11.213.429		11.847.505	
		10.423		10.478		10.537		10.600
23	9 966 472		10.593.503		11.223.966		11.858.105	
		10.424		10.479		10.538		10.601
24	9.976 896		10.603.982		11.234.504		11.868.705	
		10.425		10.480		10.539		10.603
25	9.987.321		10.614.462		11.245.043		11.879.309	
		10.425		10.481		10.540		10.604
26	9.997.746		10.624.943		11.255.583		11.889.913	
		10.426		10.482		10.541		10.605
27	10.008.172		10.635.425		11.266.124		11.900.518	
		10.427		10 483		10.542		10.606
28	10.018.599		10.645.908		11.276.666		11.911.124	
		10.428		10.484		10.543		10 607
29	10.029.027		10.656.392		11.287.209		11.921.731	
		10.429		10.485		10.544		10.608
30	10.039.456		10.666.877		11.297.753		11.932.339	
		10.430		10.486		10.545		10.609
31	10 049 886		10.677.363		11.308.298		11.942.948	
		10.431		10.487		10.546		10.610
32	10.060.317		10.687.850		11.318.844		11.953.558	
		10.432		10.488		10.548		10 611
33	10.070.749		10 698.338		11 329.392		11.964.169	
		10.433		10.489		10.549		10.612
34	10.081.182		10 708.827		11.339.941		11.974.781	
		10.433		10.490		10.550		10 613
35	10 091.615		10.719.317		11.350.491		11.985.394	
		10.434		10.491		10 551		10.615
36	10 102.049		10.729 808		11.361.042		11.996.009	
		10.435		10.492		10.552		10.616
37	10.112.484		10.740.302		11.371.594		12.006.625	
		10 436		10.493		10 553		10 617
38	10.122 920		10.750.793		11.382.147		12.017.242	
		10.437		10.493		10.554		10 618
39	10.133.357		10 761.286		11.392.701		12.027.860	
		10.438		10.494		10 555		10.619
40	10.143.795		10.771.780		11.403.256		12.038.479	
		10.439		10.495		10.556		10 620
41	10.154.234		10 782.275		11.413.812		12.049.099	
		10.440		10.496		10.557		10 621
42	10.164.674		10.792.771		11.424.369		12.059.720	
		10.441		10.497		10.558		10 622
43	10.175.115		10 803.268		11.434.927		12.070.342	
		10.442		10.498		10.559		10.623
44	10.185.557		10 813.765		11.445.486		12.080.965	
		10.443		10.499		10.560		10.625
45	10.196.000		10 824.265		11.456.046		12.091.592	
		10.443		10.500		10.561		10.626
46	10.206.443		10.834.765		11.466.607		12.102.216	
		10.444		10.501		10 562		10.627
47	10.216 887		10.845.266		11.477.169		12.112.843	
		10.445		10.502		10.563		10 628
48	10.227.332		10.855 768		11.487.732		12.123.471	
		10.446		10.503		10.564		10 629
49	10.237 778		10.866.271		11 498.296		12.134.100	
		10.447		10.504		10.565		10 630
50	10.248.225		10.876.775		11.508.861		12.144.730	
		10.448		10.505		10.566		10.631
51	10 258.673		10.887.280		11.519.427		12.155.361	
		10.449		10 506		10.567		10 632
52	10.269.122		10.897.786		11.529.994		12.165 993	
		10.450		10.507		10.568		10.633
53	10 279.572		10.908.293		11.540.562		12.176.626	
		10 451		10.508		10.569		10.635
54	10.290.023		10.918.801		11.551.131		12.187.261	
		10.452		10.509		10.570		10.636
55	10.300 475		10.929.310		11.561.701		12.197.897	
		10 453		10.510		10.571		10.637
56	10.310.928		10.939.820		11.572.272		12.208.534	
		10 454		10.511		10.573		10 638
57	10.321 382		10.950 331		11.582.845		12.219.172	
		10.455		10.512		10.574		10.639
58	10.331 837		10.960 843		11.593.419		12.229.81 1	
		10.455		10.513		10.575		10.640
59	10.342 292		10.971.356		11.603.994		12.240.45 1	
		10.456		10.514		10.576		10.641

Min.	20 Degr. Equal parts of a Merid.	Difference of equ. par.	21 Degr. Equal parts of a Merid.	Difference of equ. par.	22 Degr. Equal parts of a Merid.	Difference of equ. par.	23 Degr. Equal part of a Merid.	Difference of equ. par.
0	12.251 292	10.642	12 891 873	10 712	13·536 762	10 786	14 186·216	10 864
1	12.261 934	10.634	12.902.585	10 713	13·547·548	10.787	14·197·080	10.866
2	12 272·578	10·645	12,913·298	10·715	13·558·335	10.789	14·207·946	10·867
3	12 283 223	10.646	12·924·013	10·716	13·569 124	10.790	14·218·813	10 868
4	12.293 869	10.647	12 934 729	10·717	13·579·914	10·791	14·229·681	10·870
5	12·304·516	10.648	12·945·446	10·718	13·590·705	10·792	14·240·551	10·871
6	12·315 164	10.649	12·956.164	10 719	13·601·497	10 794	14·251·422	10 873
7	12·325.813	10 650	12·966 883	10·721	13·612 291	10·795	14·262·275	10.874
8	12·336.463	10·651	12·977·604	10 722	13·623·086	10·796	14·273·149	10.875
9	12 347 114	10.653	12·988·326	10·723	13 633·882	10·798	14 284·024	10·877
10	12·357·767	10·654	12·999·049	10·724	13 644·680	10·799	14·294·901	10·878
11	12·368 421	10.655	13.009 773	10·725	13·655 479	10·800	14·305·779	10·879
12	12·379.076	10.656	13.020·498	10·727	13.666 279	10.801	14·316·658	10·881
13	12·389·732	10·657	13·031·225	10·728	13·677·070	10.803	14·327 539	10 882
14	12.400·389	10.658	13·041·953	10·729	13·687·873	10 804	14 338·421	10·883
15	12.411.047	10.659	13 052 682	10·730	13·698·677	10·805	14·349·304	10.885
16	12·421·706	10·661	13·063·412	10·731	13·709·492	10.807	14·360·189	10·886
17	12·432·367	10.662	13·074 143	10·733	13 720·299	10·808	14·371·075	10·887
18	12.443·029	10.663	13.084·876	10·734	13·731·107	10 809	14 381·962	10·889
19	12·453·692	10·664	13·095·610	10·735	13·741·916	10 810	14 392·851	10·890
20	12·464·356	10·665	13·106·345	10·736	13·752 726	10 812	14·403·741	10·892
21	12·475·021	10.666	13.117 081	10·738	13·763·538	10.813	14·414·633	10·893
22	12·485 687	10.667	13·127.819	10·739	13·774·351	10 814	14·425·526	10·894
23	12 496·354	10.669	13·138·558	10 740	13·785·165	10.816	14·436 420	10·896
24	12 507·023	10.670	13·149·298	10·741	13·795·981	10.817	14·447·316	10·897
25	12 517·693	10.671	13·160 039	10·742	13·806·798	10.818	14·458·213	10.898
26	12·528·364	10.672	13·170·781	10.744	13·817·616	10.820	14·499·111	10·900
27	12.539·036	10 673	13·181·525	10·745	13 828.436	10·821	14·480 011	10·901
28	12·549·709	10·674	13.192·270	10.746	13·839·257	10 822	14·490 912	10·903
29	12.560·383	10·676	13·203·016	10·747	13·850·079	10 823	14·501·815	10·904
30	12·571·059	10·677	13·213·763	10·749	13·860·902	10·825	14·512·719	10·905
31	12·581·736	10·678	13·224·512	10·750	13·871·727	10·826	14·523·624	10·907
32	12·592·414	10·679	13·235·262	10·751	13·882·553	10 827	14·534·531	10·908
33	12.603·093	10.680	13·246·013	10·752	13·893·380	10·829	14 545 439	10·909
34	12.613·773	10·681	13·256·765	10·754	13·904·209	10·830	14·556 348	10·911
35	12.624·454	10·682	13·267·519	10·755	13·915·039	10 821	14 567·259	10 912
36	12·635·137	10·684	13·278·274	10·756	13·925·870	10·833	14·578 171	10·914
37	12·645·821	10.684	13·289·030	10 757	13 936·703	10·834	14·589·085	10·915
38	12·656·506	10·686	13.299·787	10·758	13 947 537	10·835	14·600·000	10·916
39	12·667·192	10.687	13·310·545	10·760	13·958 372	10·837	14·610·916	10·918
40	12·677·879	10·688	13·321·305	10·761	13·969·209	10·838	14 621·834	10·919
41	12.688·567	10·690	13·332·066	10·762	13·980·047	10.839	14·632·753	10·921
42	12·699·257	10 691	13·342·828	10·763	13·990·886	10.840	14 643·674	10·922
43	12 709·948	10·692	13·353·591	10·765	14·001·726	10 842	14·654·596	10·923
44	12.720·640	10·693	13·364·356	10 766	14·012·568	10·843	14 665·519	10·925
45	12 731·333	10.694	13·375·122	10·767	14·023·411	10·844	14·676·444	10·926
46	12·742·027	10.696	13 385·889	10 768	14·034·255	10·846	14·687·370	10·928
47	12·752·723	10.697	12.396·657	10·770	14·045 101	10 847	14·698 298	10·929
48	12.763·420	10.698	13·407·427	10·771	14·055·948	10·848	14 709·227	10 930
49	12 774·118	10.699	13·418·198	10·772	14·066·796	10·850	14·720 157	10·932
50	12·784·817	10·700	13·428 970	10·773	14·077·646	10·851	14·731 089	10·933
51	12 795·517	10·701	13·439·742	10·775	14·088·497	10·852	14·742·022	10·935
52	12·806·218	10·703	13·450·518	10·776	14·099·349	10·854	14·752·957	10 936
53	12.816·921	10·704	13·461·294	10·777	14·110·203	10 855	14·763 893	10 937
54	12·827·625	10.705	13 472·071	10·779	14·121·058	10·856	14·774·830	10·939
55	12 838·330	10.706	13·482·850	10·780	14·131·914	10.858	14·785·769	10·940
56	12·849·036	10·707	13·493·630	10·781	14·142·772	10·859	14·796·709	10·942
57	12·859·743	10.709	13·504·411	10·782	14·153·631	10.860	14·807·651	10·943
58	12·870·452	10·710	13·515·193	10 784	14·164 491	10·862	14 818 594	10.944
59	12 881·162	10·711	13·525·977	10·785	14·175·353	10·863	14·829·538	10·946

Min.	24 Degr. Equal parts of a Merid.	Difference of equ. par.	25 Degr. Equal parts of a Merid.	Difference of equ. par.	26 Degr. Equal parts of a Merid.	Difference of equ. par.	27 Degr. Equal parts of a Merid.	Difference of equ. par.
0	14.840.484		15.493.878		16.164.663		16.835.136	
		10.947		11.035		11.127		11.224
1	14.851.431		15.510.913		16.175.790		16.846.360	
		10.949		11.036		.129		11.226
2	14.862.380		15.521.949		16.186.919		16.857.586	
		10.950		.038		.130		11.228
3	14.873.330		15.532.987		16.198.049		16.868.814	
		10.952		.039		.132		11.229
4	14.884.282		15.544.026		16.209.181		16.880.043	
		10.953		.041		.133		11.231
5	14.895.235		15.555.067		16.220.314		16.891.274	
		10.954		.042		.135		11.233
6	14.906.189		15.566.109		16.231.449		16.902.507	
		10.956		.044		.137		11.234
7	14.917.145		15.577.153		16.242.586		16.913.741	
		10.957		.045		.138		11.236
8	14.928.102		15.588.198		16.253.724		16.924.977	
		10.959		.047		.140		11.238
9	14.939.061		15.599.245		16.264.864		16.936.215	
		10.960		.048		.141		11.239
10	14.950.021		15.610.293		16.276.005		16.947.454	
		10.962		11.050		11.143		11.241
11	14.960.983		15.621.343		16.287.148		16.958.695	
		.963		.051		.145		11.243
12	14.971.946		15.632.394		16.298.293		16.969.938	
		.964		.053		.146		11.245
13	14.982.910		15.643.447		16.309.439		16.981.183	
		.966		.054		.148		11.246
14	14.993.876		15.654.501		16.320.587		16.992.429	
		.967		.056		.149		11.248
15	15.004.843		15.665.557		16.331.736		17.003.677	
		.969		.057		.151		11.250
16	15.015.812		15.676.614		16.342.887		17.014.927	
		.970		.059		.153		11.251
17	15.026.782		15.687.673		16.354.040		17.026.178	
		.972		.060		.154		11.253
18	15.037.754		15.698.733		16.365.194		17.037.431	
		.973		.062		.156		11.255
19	15.048.727		15.709.805		16.376.350		17.048.686	
		.974		.063		.157		11.256
20	15.059.701		15.720.858		16.387.507		17.059.942	
		10.976		11.065		11.159		11.258
21	15.070.677		15.731.923		16.398.666		17.071.200	
		.977		.067		.161		11.260
22	15.081.654		15.742.990		16.409.827		17.082.460	
		.979		.068		.162		11.261
23	15.092.633		15.754.058		16.420.989		17.093.721	
		.980		.070		.164		11.263
24	15.103.613		15.765.128		16.432.153		17.104.984	
		.982		.071		.165		11.265
25	15.114.595		15.776.199		16.443.318		17.116.249	
		.983		.073		.167		11.267
26	15.125.578		15.787.272		16.454.485		17.127.516	
		.985		.074		.169		11.268
27	15.136.563		15.798.346		16.465.654		17.138.784	
		.986		.076		.170		11.270
28	15.147.549		15.809.422		16.476.824		17.150.054	
		.988		.077		.172		11.272
29	15 158.537		15.820.499		16.487.996		17.161.326	
		.989		.079		.174		11.273
30	15.169.526		15.831.578		16.499.170		17.172.599	
		10.990		11.080		11.175		11.275
31	15.180.516		15.842.658		16.510.345		17.183.874	
		.992		.082		.177		11.277
32	15.191.508		15.853.740		16.521.522		17.195.151	
		.993		.083		.178		11.278
33	15.202.501		15.864.823		16.532.700		17.206.429	
		.995		.085		.180		11.280
34	15.213.496		15.875.908		16.543.880		17.217.689	
		.996		.086		.182		11.282
35	15.224.492		15.886.994		16.555.062		17.228.971	
		.998		.088		.183		11.284
36	15.235.490		15.898.082		16.566.245		17.240.255	
		.999		.090		.185		11.285
37	15.246.489		15.909.172		16.577.430		17.251.540	
		11.001		.091		.187		11.287
38	15.257.490		15.920.263		16.588.617		17.262.827	
		11.002		.093		.188		11.289
39	15.268.492		15.931.356		16.599.805		17.274.116	
		11.004		.094		.190		11.290
40	15.279.496		15.942.450		16.610.995		17.285.406	
		11.005		11.096		11.191		11.292
41	15.290.501		15.953.546		16.622.186		17.296.698	
		.007		.097		.193		11.294
42	15.301.508		15.964.643		16.633.379		17.307.992	
		.008		.099		.195		11.295
43	15.312.516		15.975.742		16.644.574		17.319.288	
		.010		.100		.196		11.297
44	15.323.526		15.986.842		16.655.770		17.330.585	
		.011		.102		.198		11.299
45	15.334.537		15.997.944		16.666.968		17.341.884	
		.012		.104		.200		11.301
46	15.345.549		16.009.048		16.678.168		17.353.185	
		.014		.105		.201		11.303
47	15.356.563		16.020.153		16.689.369		17.364.488	
		.015		.107		.203		11.304
48	15.367.578		16 031.260		16 700.572		17.375.792	
		.017		.108		.205		11.306
49	15.378.595		16.042.368		16.711.777		17.387.098	
		.018		.110		.206		11.308
50	15.389.613		16.053.478		16.722.983		17.398.406	
		11.020		11.111		11.208		11.309
51	15.400.633		16.064.589		16.734.191		17.409.715	
		.021		.113		.210		11.311
52	15.411.654		16 075.702		16.745.401		17.421.026	
		.023		.115		.211		11.313
53	15.422.677		16 086.817		16.756.612		17.432.339	
		.024		.116		.213		11.315
54	15.433.701		16.097 933		16 767.825		17.443.654	
		.026		.118		.214		11.316
55	15.444 727		16 109 051		16.779.039		17.454 970	
		.027		.119		.216		11.318
56	15.455.754		16.120.170		16.790.255		17.466.288	
		.029		.121		.218		11.320
57	15.466 783		16.131.291		16.801.473		17.477.608	
		.030		.122		.219		11.322
58	15.477.813		16.142.413		16.812.692		17.488.930	
		.032		11.124		.221		11.323
59	15.488 845		16.153 537		16.823.913		17.500.253	
		11.033		11.126		11.223		11 325

Min.	28 Degr. Equal parts of a Merid.	Difference of equ. par.	29 Degr. Equal parts of a Merid.	Difference of equ. par.	30 Degr. Equal parts of a Merid.	Difference of equ. par.	31 Degr. Equal parts of a Merid.	Difference of equ. par.
0	17·511·578	11·327	18·194 351	11·435	18 883·768	11·548	19 580 154	11·668
1	17·522·905	11·329	18 205 786	11 437	18·895·316	11 550	19 591·822	11·670
2	17·534·234	11·330	18·217 223	11·439	18·906 866	11 552	19·603·492	11·672
3	17·545·564	11·332	18·228·662	11·440	18·918·418	11·554	19 615·164	11·674
4	17·556 596	11 334	18·240.102	11·442	18·929·972	11·556	19·626·838	11·676
5	17·568 230	11·336	18 251 ·544	11·448	18 941·528	11·558	19·038·514	11.678
6	17·579·566	11 337	18 262.988	11 446	18·953·086	11·560	19 650·192	11·680
7	17·590·903	11·339	18·274·434	11·448	18·964·646	11 562	19·661·874	11·682
8	17.602 242	11 341	18·285·882	11 450	18 976·208	11·564	19 673·554	11·684
9	17·613·583	11 343	18·297·332	11·452	18·987·772	11·566	19 685·238	11·686
10	17.624·926	11·345	18 308·784	11·453	18·999·338	11·568	19.696·924	11·688
11	17.636·271	11 346	18 320·237	11 455	19.010·905	11·570	19·708 612	11·690
12	17·647·617	11 347	18·331·692	11·457	19.022 476	11·572	19·720·302	11·692
13	17·658·965	11·350	18·343·149	11·459	19·034.048	11·574	19·731 994	11·695
14	17·670·315	11 352	18·354 608	11·461	19.045·622	11 576	19 743 699	11 697
15	17·681·667	11·353	18·366·069	11·463	19·057·198	11 578	19 755·396	11 699
16	17·693 ·020	11 355	18 377·532	11 465	19·068·776	11·580	19 767·085	11·701
17	17·704·375	11 357	18·388 997	11·466	19 080·356	11 582	19 778 786	11·703
18	17·715·732	11·359	18·400·463	11·468	19 091 ·938	11·584	19 790·489	11·705
19	17·727·091	11·361	18·411 931	11·470	19 103 522	11·586	19·802·194	11·707
20	17·738·452	11·362	18 423·401	11·472	19·115·108	11·588	19·813 901	11·709
21	17·749·814	11·364	18·434·873	11·474	19 126·696	11·590	19·825 610	11·711
22	17·761.178	11 366	18·446·347	11 476	19 138.286	11·592	19·837·321	11·713
23	17·772·544	11 368	18·457·823	11·478	19.149·878	11·594	19·849 034	11·715
24	17·783·912	11·369	18·469·301	11·480	19·161·472	11 595	19·860.748	11 717
25	17·795·281	11·371	18·480·781	11·482	19·173 067	11·597	19·872 466	11·719
26	17·806·652	11·373	18·492·263	11·483	19·184·664	11·599	19 884·185	11·722
27	17·818·025	11·375	18 503·746	11·485	19 196 263	11 601	19·895 907	11·724
28	17·829.400	11·377	18·515·231	11·487	19·207 864	11·603	19 907 631	11·726
29	17.840·777	11·378	18.526 718	11 489	19·219·467	11·605	19 919 357	11·728
30	17 852·155	11·380	18·538·207	11 491	19·231·072	11·607	19·931·085	11·730
31	17.863·535	11·382	18·549.698	11 493	19.242·679	11·609	19 942·815	11·732
32	17·874 917	11·384	18 561.191	11 495	19 254.288	11·611	19 954·547	11·734
33	17·886 301	11·386	18·572·686	11·497	19·265·899	11 613	19 966 281	11·736
34	17 897 687	11·387	18·584·183	11·499	19 277·512	11 615	19·978 017	11 738
35	17·909·074	11·389	18·595·682	11·500	19·289·127	11·617	19·989 755	11·740
36	17 920·463	11·391	18 607.182	11·502	19 300·734	11·619	20 001 496	11·742
37	17·931.854	11·393	18·618.684	11·504	19 312·353	11 621	20·013 237	11·745
38	17·943·247	11·395	18·630.188	11 506	19·323 974	11·623	20·024·982	11 747
39	17 954·642	11·396	18·641·694	11·508	19 335 597	11·625	20.036·729	11·749
40	17·966.038	11·398	18·653·202	11·510	19·347 222	11·627	20 048·478	11·751
41	17.977·436	11·400	18·664.712	11·512	19·358·849	11 629	20·060·229	11 753
42	17·988·836	11·402	18.676·224	11·514	19·370·478	11·631	20·071 982	11·755
43	18 000·238	11·404	18 687·738	11·516	19 382·109	11·633	20·083·737	11·757
44	18.011.642	11·406	18·699.254	11·518	19 393·742	11·635	20·095·494	11 759
45	18.023 048	11·407	18.710 772	11 520	19·405 377	11·637	20 107 253	11·761
46	18·034·455	11·409	18·722 292	11·521	19·417·014	11·639	20·119·014	11·764
47	18 045·864	11·411	18·733·813	11·523	19·428·653	11 641	20 130·778	11 766
48	18 057·275	11·413	18·745·336	11·525	19·440·294	11·644	20·142·544	11 768
49	18·068 688	11 415	18.756·861	11·527	19.451 938	11·646	20 154·312	11·770
50	18.080 103	11·417	18 768.388	11·529	19·463·584	11·648	20.166 082	11·772
51	18.091 520	11·418	18.779·917	11 531	19 475·232	11 650	20·177·854	11·774
52	18·102 938	11·420	18.791 448	11·533	19·486·882	11·652	20·189·628	11·776
53	18.114 358	11·422	18·802.981	11 535	19·498·534	11·654	20 201·404	11·778
54	18.125.780	11·424	18 814 516	11·527	19.510.188	11 656	20 213 182	11·781
55	18.137 204	11·426	18·826 053	11·529	19·521·844	11·658	20·224·963	11 783
56	18.148.630	11·428	18·837·592	11·541	19 533·502	11·660	20 236 746	11·785
57	18·160.058	11·429	18·849·133	11·542	19 545·162	11·662	20 248·531	12·787
58	18.171.487	11·431	18·860·676	11·545	19 556 824	11 664	20·260·318	11·789
59	18 182 918	11·433	18 872.221	11·547	19·568·488	11 666	20 272·107	11·791

Min.	32 Degr. Equal parts of a Merid.	Difference of equ. par.	33 Degr. Equal parts of a Merid.	Difference of equ. par.	34 Degr. Equal parts of a Merid.	Difference of equ. par.	35 Degr. Equal parts of a Merid.	Difference of equ. par.
0	20.283.838	11.793	20.935.367	11 925	21.714.945	12.064	22.413 047	12 210
1	20 295.631	11.795	21 007 292	11 928	21.727.009	12 066	22.455.257	12 212
2	20.307.487	11.798	21 019.220	11.930	21.739.075	12.069	22.467.469	12 215
3	20 319 285	11.807	21.031 150	11.932	21.751.144	12 071	22.479.684	12 217
4	20.331.085	11 802	21.043 0 2	11 934	21.763.215	12.074	22.491.901	12 220
5	20.342 887	11.804	21.055.016	11 937	21.775.289	12.076	22.504.221	12 222
6	20 354 691	11.805	21 066.953	11.939	21.787.365	12 078	22.516.443	12 225
7	20.366.497	11.808	21.078.892	11.941	21.799.443	12.081	22.528.668	12.227
8	20.378 305	11.811	21.090.833	11.943	21.811.524	12.083	22.540.895	12.230
9	10 390.116	11.813	21.102 776	11.946	21 823 607	12 085	22.553.125	12.232
10	20.401.929	11 815	21.114.722	11.948	21.835 692	12 088	22 565 357	12 235
11	20.413 744	11 817	21 126.670	11 950	21.847.780	12.090	22.577.592	12.237
12	20.425 561	11.819	21.138.620	11 953	21.859.870	12 093	22.589.829	12.240
13	20.437.380	11.821	21.150 573	11 955	21.871 963	12.095	22 602 069	12 242
14	20.449.201	11.824	21 162.528	11.957	21.884.058	12 097	22.614.311	12.245
15	20.461.025	11.826	21.174.485	11.959	21.896.155	12.100	22 626.556	12.247
16	20.472.851	11.828	21.186.444	11 962	21.908.255	12.102	22.638.803	12 250
17	20 484.679	11.830	21.198.406	11.964	21.920.357	12.105	22.651.053	12 252
18	20.496 509	11 832	21 210.370	11.966	21 932.462	12 107	22.663.305	12.255
19	20.508.341	11.835	21 222 336	11.969	21.944.569	12.109	22.675 560	12.257
20	20.520.176	11.837	21.234.305	11.971	21 956 678	12.112	22 687.817	12.260
21	20.532 013	11.839	21 246.276	11 973	21.968 790	12 114	22.700.077	12.262
22	20.543 852	11.841	21 258.249	11 975	21.980.904	12.117	22.712.339	12.265
23	20 555 693	11.843	21.270.224	11 978	21.993 021	12.119	22.724.604	12.268
24	20 567.536	11.845	21.282.202	11.980	22.005 140	12.121	22 736.872	12.270
25	20 579.381	11.848	21.294.182	11.982	22.017.261	12.124	22.749.142	12.273
26	20 591 229	11.850	21.306 164	11.985	22.029.385	12.126	22.761.415	12.275
27	20 603.079	11.852	21.318.149	11 987	22.041 511	12 129	22 773 690	12.278
28	20 614.931	11 854	21 330.136	11.989	22.053.640	12.131	22.785 968	12.280
29	20 626.785	11 856	21 342.125	11.992	22 065.771	12.134	22.798.248	12.283
30	20.638.641	11.859	21.354 117	11.994	22 077.905	12.136	22.810.531	12.285
31	20.650 500	11.861	21 366 111	11 996	22.090.041	12.138	22.822.816	12.288
32	20 662 361	11.863	21.378 107	11.998	22.102.179	12 141	22.835.104	12.290
33	20 674.224	11.865	21.390.105	12.001	22.114 320	12 143	22.847.394	12.293
34	20.686.089	11.867	21.402.106	12.003	22 126.463	12.146	22.859.687	12.296
35	20 697.956	11.870	21.414.109	12.005	22.138 609	12.148	22.871.983	12.298
36	20.709.826	11.872	21 426.114	12.008	22.150 757	12.150	22 884 281	12.301
37	20.721 702	11.874	21.438 122	12.010	22 162.907	12.153	22.896.582	12.303
38	20 733.576	11.876	21.450.132	12 012	22.175.060	12 155	22.908.885	12 306
39	20 745.452	11 878	21.462.144	12.015	22.187 215	12.158	22.921 191	12.308
40	20.757.330	11 881	21.474.159	12 017	22.199 373	12 160	22.933.499	12.311
41	20.769 211	11.883	21.486.176	12.019	22.211.533	12 163	22.945 810	12.314
42	20.781 094	11.886	21.498.195	12.022	22.223 696	12.165	22 958.124	12.316
43	20 792.979	11.887	21.510.217	12.024	22.235 861	12.168	22.970 440	12 319
44	20.804.866	11 890	21.522 241	12.026	22.248 029	12.170	22 982.759	12.321
45	20.816.756	11.892	21.534.267	12.029	22.260.199	12.173	22.995.080	12.324
46	20.828.648	11.894	21.546.296	12.031	22 272.372	12 175	23 007.404	12 326
47	20 840.542	11.896	21.558.327	12.033	22 284 547	12 178	23 019.730	12.329
48	20.852 438	11 898	21 570.360	12.036	22.296.725	12 180	23.032 059	12.332
49	20.864.336	11.901	21.582.396	12.038	22.308.905	12.182	23 044 391	12 334
50	20.876 237	11.903	21 594.434	12.040	22.321.087	12 185	23.056.725	12.337
51	20.888.140	11.905	21.606.474	12.043	22.333.272	12 187	23.069.062	12.339
52	20.900.045	11.907	21.618 517	12 045	22.345 459	12.190	23.081.401	12.342
53	20.911.952	11.910	21.630.562	12.048	22.357.649	12.192	23 093.742	12 345
54	20.923 862	11.912	21.642 610	12.050	22.369.841	12.195	23.106.088	12.347
55	20.935.774	11.914	21.654.660	12.052	22.382.036	12.197	23.118.435	12.350
56	20.947.688	11.916	21.666.712	12.055	22.394.233	12.200	23.130 785	12.352
57	20.959.604	11.919	21.687.767	12.057	22.406.433	12.202	23.143.137	12.355
58	20.971.523	11 921	21.690.824	12 059	22.418.635	12.205	23.155.492	12.358
59	20.983 444	11.923	21.720.883	12.062	22.430 840	12 207	23.167.850	12.360

Min.	36 Degr. Equal parts of a Merid.	Difference of equ. par.	37 Degr. Equal parts of a Merid.	Difference of equ. par.	38 Degr. Equal parts of a Merid	Difference of equ. par.	39 Degr. Equal parts of a Merid.	Difference of equ. par.
0	23·180·210	12 363	23·926·786	12·524	24 683·145	12·693	25·449·892	12·870
1	23·192·573	12·365	23 939 310	12·526	24·695·838	12·695	25·462·762	12·873
2	23·204 938	12·368	23·951·836	12·529	24·708·533	12 698	25·475·635	12·876
3	23 217 306	12·371	23 964·365	12·532	24·721 231	12 701	25·488·511	12·879
4	23·229·677	12·373	23 97 · 897	12 535	24·733·932	12·704	25·501·390	12·882
5	23·242 050	12·376	23·989 432	12·537	24·746·636	12·707	25·514·272	12·885
6	23 254·426	12·379	24 001·969	12·540	24·659·343	12,710	25·527 157	12·888
7	23 266·805	12·381	24·014·509	12·543	24 772·053	12 713	25·540·045	12 891
8	23·279 186	12 384	24 027·052	12·546	24 784·766	12·716	25 552·936	12·894
9	23·291·570	12·386	24·039·598	12·548	24 797 482	12·719	25·565 830	12 898
10	23·303 956	12·389	24 052 146	12·551	24·810·201	12·722	25 578·733	12 901
11	23 316·345	12 392	24 064·697	12·554	24 822 923	12·724	25·591·639	12·904
12	23·328 737	12·394	24·077·251	12 557	24·835 647	12 727	25 604·533	12·907
13	23 341·133	12·397	24·089·808	12·560	24 848 374	12 730	25 617·440	12·910
14	23·353·530	12·400	24·102 368	12·562	24·861 104	12·733	25·630·350	12·913
15	23·365·930	12 402	24 114 930	12·565	24·873 837	12·736	25·643 263	12·916
16	23·378 332	12 405	24 127 495	12 568	24·886·573	12·739	25 656·179	12·919
17	23 390 837	12·408	24 140·063	12·571	24·899 312	12 742	25·669·098	12 922
18	23·403·245	12·410	24 152·634	12 573	24·912·054	12·745	25·682 020	12·925
19	23·415·655	12·413	24·165·207	12·576	24·924·799	12 748	25·694·945	12·928
20	23·428·068	12 416	24 177·783	12·579	24·937 547	12·751	25 707·873	12·931
21	23·440·484	12·418	24 190 362	12·582	24·950 298	12·754	25·720·804	12·934
22	23·452 902	12·421	24 202·944	12 585	24·963·052	12·757	25·733 738	12·937
23	23·465 323	12 423	24 215·528	12·587	24·975·809	12 760	25·746·675	12 941
24	23·477·746	12·426	24·228·116	12·590	24·988·569	12·763	25·759·616	12·944
25	23·490·172	12·429	24 240·706	12·593	25·001 332	12·766	25·772 560	12·947
26	23 502·601	12·432	24·253·299	12 596	25 01 ·097	12·768	25·785·507	12 950
27	23·515 033	12·434	24 265·895	12·599	25·026·865	12 771	25·798·457	12·953
28	23·527·467	12·437	24·278·494	12 601	25 039 636	12 774	25 811·410	12·956
29	22 539·904	12 440	24 291·095	12·604	25·052 410	12·777	25·824·366	12·959
30	23 552·344	12·442	24·303 699	12 607	25·065·187	12 780	25·837 325	12·962
31	23·564·786	12·445	24·316 306	12 610	25·077 967	12·783	25 850·287	12·965
32	23 577·231	12 448	24 328·916	12 613	25 090·750	12 786	25 863·252	12·969
33	23·589·679	12·450	24·341 529	12·615	25·103 536	12·789	25·876·221	12·972
34	23 602·129	12·453	24·354·144	12 618	25 116 325	12 792	25 889 193	12 975
35	23·614·582	12·456	24·366·762	12 621	25·129 117	12·795	25 902 168	12·978
36	23·627·038	12·458	24·379 383	12·624	25·141·912	12·798	25 915 146	12·981
37	23·639·496	12 461	24 392 007	12·627	25·154 710	12·801	25·928 127	12 984
38	23 651·957	12 464	24 404·634	12 630	25·167·511	12·804	25·941 111	12·987
39	23·664·421	12·466	24·417·264	12·632	25·180·315	12 807	25 954 098	12·990
40	23·676 887	12·469	24·429·896	12·635	25·193·122	12·810	25·967·088	12 994
41	23 689·356	12·472	24·442·531	12·638	25 205·932	12·813	25·980 082	12 997
42	23·701 828	12·475	24·455 169	12·641	25·218·745	12 816	25·993 079	13 000
43	23·714·303	12 477	24·467·810	12 644	25 231·561	12,819	26·006 079	13 003
44	23·726·780	12·480	24 480·454	12·647	25·244·380	12 822	26·019·072	13 006
45	23·739·260	12·483	24·493 101	12·650	25·257 202	12 825	26·032 078	13·009
46	23·751·743	12·486	24·505·751	12·652	25 270·027	12·828	26·045 097	13·012
47	23·764·228	12 488	24·518·403	12 655	25·282 855	12·831	26·058·109	13 016
48	23 776·716	12·491	24 531·058	12·648	25·295·686	12·83 ·	26·071·125	13·019
49	23·789 207	12·494	24·543·716	12·661	25 308·520	12·837	26·084 144	13·022
50	23·801·701	12·496	24·556 377	12·664	25·321·357	12·840	26·097 166	13·025
61	23·814·197	12·499	24·569·041	12·667	25·334 197	12·843	26·110·191	13·028
52	23 226·696	12 502	24·581·708	12·670	25·347 040	12·845	26·123 219	13·031
53	23·839·198	12·504	24·594·378	12·672	25·359 886	12·84 ·	26 136 250	13·035
54	23·851·702	12·507	24·607·050	12 675	25 372·735	12·852	26 149 285	13·038
55	23·864·209	12·510	24·619·725	12·678	25·385·587	12 855	26·162·323	13·041
56	23·876·719	12·513	24·632·402	12·681	25·398 442	12·85 ·	26·175 364	13·044
57	23 889·232	12·515	24·645·084	12·684	25·411·300	12·· ·	26·188 408	13·047
58	23·901·747	12·518	24·657·768	12·687	25·424 161	12·864	26 201·455	13·050
59	23·914·265	12·521	24·670 455	12·690	25·437·025	12 867	26 214·505	13·054

Min.	40 Degr. Equal parts of a Merid.	Difference of equ par.	41 Degr. Equal parts of a Merid.	Difference of equ.par.	42 Degr. Equal parts of a Merid	Difference of equ. par.	43 Degr. Equal parts of a Merid.	Difference of equ. par.
0	26 227·559		27·016 632		27·817·839		28.631.657	
		13·057		13·253		13·459		13·676
1	26·240 616		27·029·885		27·831·295		28 645·333	
		13·060		13·256		13·463		13·680
2	26·253 676		27 043·141		27·844·758		28 659·013	
		13 063		13·260		13·466		13 684
3	26·266·739		27·056·401		27 858·224		28 672·697	
		13·065		13·263		13 470		13 688
4	26·279·805		27 069·664		27·871 694		28·686·385	
		13·070		13·266		13 473		13 691
5	26·292·875		27·082·930		27·885 167		28 700 076	
		13·073		13·270		13·477		13·695
6	26·305 948		27·096·200		27·898 644		28 713 771	
		13·076		13·273		13·481		13·699
7	26 319·024		27·109·473		27·912·125		28 727·470	
		13 079		13·277		13·484		13·703
8	26·332·103		27·122 750		27·925 609		28 741·173	
		13·082		13·280		13·488		13·706
9	26·345·185		27·136·030		27·939·097		28·754 879	
		13·086		13 283		13·491		13·710
10	26·358·271		27·149·313		27 952·588		28 768·589	
		13 086		13·287		13·495		13·714
11	26 371·360		27·162·600		27·966·083		28·782·303	
		13·092		13·290		13·498		13·718
12	26·384·452		27 175·890		27·979·581		28·796·021	
		13·095		13 293		13·502		13·721
13	26·397·547		27·189·183		27 993·083		28·809·742	
		13·098		13·297		13·505		13·725
14	26·410 645		27·202 480		28·006·588		28 823·467	
		13 102		13·300		13·509		13·729
15	26·423·747		27·215·780		28·020·097		28 837·196	
		13·105		13·304		13·513		13·733
16	26·436·852		27·229·084		28·033·610		28·850·929	
		13·108		13·307		13·516		13·736
17	26 449 960		27 242 391		28·047·126		28·864·665	
		13·111		13·310		13·520		13·740
18	26 463 071		27 255·701		28·060 646		28·878 405	
		13·115		13 314		13·523		13·744
19	26·476·186		27·269·015		28·074 169		28·892·149	
		13·118		13·317		13·527		13 748
20	26·489·304		27·282·332		28·087 696		28·905·897	
		13·121		13·321		13·531		13·751
21	26·502·425		27·295·653		28·101·227		28·919·648	
		13·124		13·324		13·534		13·755
22	26 515·549		27·308·977		28·114·761		28 933·403	
		13·128		13·327		13·538		13·759
23	26·528 677		27·322·304		28·128·299		28·947·162	
		13·131		13·331		13·541		13·763
24	26·541 808		27·335·635		28·141·840		28·960·925	
		13·134		13·334		13 545		13·766
25	26·554·942		27 348·969		28·155·385		28·974 691	
		13·137		13·338		13·548		13·770
26	26·568·079		27·362·307		28·168·933		28·988·461	
		13·141		13 341		13·552		13·774
27	26·581·220		27 375·648		28·182·485		29·002·235	
		13·144		13 345		13·556		13·778
28	26·594·364		27·388·993		28·196·041		29 016·013	
		13·147		13·348		13·559		13·782
29	26·607 511		27·402·341		28·209 600		29·029·795	
		13·150		13 351		13·563		13·785
30	26·620 661		27·415·692		28·223·163		29·043·580	
		13 154		13·355		13·567		13·789
31	26·633 842		27·429·047		28·236·730		29·057·369	
		13·157		13·358		13 570		13·793
32	26·646·999		27·442·405		28·250·300		29·071 162	
		13·160		13·362		13 574		13·797
33	26·660 159		27·455·767		28 263·874		29·084 969	
		13 163		13 365		13·577		13·801
34	26·673·322		27·469·132		28·277·451		29·098·760	
		13·167		13·369		13·581		13·805
35	26·686·489		27·482·501		28·291·032		29·112·565	
		13·170		13·372		13·585		13·808
36	26·699·659		27 495 873		28 304·617		29·126·373	
		13 173		13·376		13·588		13·812
37	26·712·832		27·509·249		28·318·205		29·140·185	
		13·177		13·379		13·592		13·816
38	26·729 009		27·522·628		28·331·807		29 154·001	
		13·180		13·382		13·596		13·820
39	26·739·189		27·536·010		28·345·403		29·167 821	
		13·183		13·386		13·599		13·824
40	26·752·372		27 549·396		28·358·902		29·181·645	
		13 186		13·389		13·603		13·828
41	26·765 558		27·562·785		28·372 505		29·195·473	
		13 190		13·393		13·607		13·831
42	26·778·648		27·576·178		28·386 112		29·209·304	
		13·193		13·396		13·610		13·839
43	26·791·841		27·589·574		28 399 722		29·223·139	
		13·196		13·400		13·614		13·835
44	26·805·037		27·602·974		28·413·336		29·236·978	
		13·200		13·403		13 617		13·843
45	26·818·237		27 616 377		28·426·953		29·250·821	
		13·203		13·407		13·621		13·847
46	26·831·440		27·629·784		28·440·574		29·264 668	
		13·206		13·410		13 625		13·851
47	26·844·646		27·643·194		28 454·199		29·278·519	
		13·210		13·414		13 628		13·855
48	26·857·856		27·656·608		28·467·827		29·292·374	
		13·213		13·417		13·632		13 858
49	26·871·069		27·670·025		28 481·459		29·306 232	
		13·216		13·421		13·636		13·862
50	26·884·285		27 683·446		28·495·095		29·320 094	
		13·220		13·424		13·640		13·866
51	26·897·505		27·696·870		28·508·735		29·333·960	
		13 223		13·428		13·643		13·870
52	26 910·728		27·710·298		28·522·378		29·347·830	
		13·226		13·431		13 646		13·874
53	26·923·954		27·723·729		28·536·025		29·361 704	
		13 230		13·435		13·651		13·878
54	26·937 184		27·737·164		28·549·676		29·375·582	
		13·233		13·438		13·654		13·882
55	26·950 417		27·750 602		28·563·330		29·389·464	
		13·236		13·442		13·658		13·886
56	26·963·653		27·764 044		28·576·988		29 403·350	
		13·240		13·445		13·662		13·889
57	26·976·893		27·777·489		28·590·650		29·417·239	
		13 243		13·449		13·665		13 893
58	26·990·136		27 790·938		28·604·315		29·431·132	
		13·246		13 452		13 669		13·897
59	27·003·382		27 804·389		28·617·984		29·445·029	
		13·250		13 456		13·673		13·901

Min.	44 Degr. Equal parts of a Merid.	Difference of equ. par.	45 Degr. Equal part of a Merid.	Difference of equ par	46 Degr. Equal parts of a Merid.	Difference of equ. par.	47 Degr. Equal parts of a merid.	Difference of equ. par.
0	29.458.930	13.905	30.301 271	14 146	31.156.423	14.399	32.028.087	14 667
1	29 472 835	13.909	30 314.417	14 150	31 170 822	14 404	32.042 754	14.671
2	29.486.744	13.913	30 328.567	14.154	31 185 226	14.408	32.057 425	14 676
3	29.500.657	13.917	30.342 721	14.158	31 199.634	14.412	32 072.101	14.681
4	29.514.574	13 921	30 356.879	14 162	31.214 046	14.417	32.086.782	14.685
5	29.528.495	13.925	30.371 041	14.166	31.228 463	14 421	32.101.467	14.690
6	29.542 420	13.929	30.385 207	14.171	31.242.884	14.426	32.116 157	14.694
7	29.556.349	13 932	30.399.378	14 175	31.257 310	14.430	32.130.851	14.699
8	29.570.281	13.936	30 413.553	14.179	31.271.740	14.434	32 145.550	14.704
9	29.584.217	13.940	30.427.732	14.183	31.286.174	14 439	32.160.254	14 708
10	29.598 157	13 944	30 441.915	14 187	31 300 613	14.443	32.174.962	14.713
11	29 612.101	13 948	30 456.102	14.191	31.315.056	14.447	32.189 675	14.717
12	29 626.049	13.952	30 470.293	14.195	31.329.503	14.452	32.204 392	14.722
13	29 640 001	13.956	30.484 488	14.200	31.343.955	14.456	32.219 114	14 727
14	29.653.957	13.960	30.498 688	14.204	31.358.411	14.461	32.233 841	14.731
15	29 667 917	13.964	30.512.892	14.208	31.372.872	14.465	32.248.573	14.736
16	29 681.881	13.968	30.527 100	14 212	31.387.337	14.469	32.263.308	14.741
17	29 695 849	13.972	30.541.312	14.216	31.401.806	14 474	32 278.049	14.745
18	29.709.821	13 976	30.555.528	14 220	31.416.280	14 478	32 292.794	14.750
19	29 723.797	13 980	30 569.748	14.225	31.430.758	14.483	32.307.544	14.755
20	29 737 777	13.984	30.583.973	14.229	31.445.241	14.487	32.322.299	14 759
21	29.751.761	13.988	30 598.202	14.233	31.459 728	14.491	32.337.058	14.764
22	29.765.749	13.992	30.612.435	14.237	31.474 219	14.496	32.351.822	14.769
23	29 779 741	13.996	30.626.672	14 241	31.488.715	14.500	32.366.591	14.773
24	29 793.737	14.000	30.640.913	14.246	31.503 215	14 505	32.381.364	14.778
25	29.807 737	14.004	30.655.159	14.250	31.517.720	14.509	32.396.142	14.783
26	29 821.741	14.008	30.669.409	14.254	31 532.229	14.514	32 410 925	14.787
27	29 835.749	14.012	30.683.663	14.258	31.546.743	14.518	32.425.712	14.792
28	29 849.761	14 016	30.697 921	14.262	31.561.261	14.522	32 440.504	14.797
29	29 863.777	14 020	30.712.183	14.267	31.575.783	14.527	32.455.301	14.801
30	29.877.797	14.024	30 726.450	14.271	31.590.310	14.531	32.470.102	14.806
31	29 891 821	14.028	30.740.721	14.275	31.604.841	14 536	32 484.908	14.811
32	29 905.849	14.032	30.754 996	14.279	31.619 377	14 540	32 499.719	14.815
33	29.919.881	14.036	30 769.275	14 284	31.633 917	14.545	32.514.534	14.820
34	29.933.917	14.040	30 783.559	14.288	31.648.462	14.549	32.529.354	14.825
35	29 947 957	14 044	30 797 847	14 292	31.663.011	14.554	32.544.179	14.830
36	29.962 001	14.048	30.812.139	14.296	31.677.545	14.558	32.559.009	14.834
37	29 976.049	14.052	30.826.435	14 301	31.692.103	14.563	32 573.843	14 839
38	29 990.101	14.056	30.840.73-	14 305	31.706 666	14.567	32.588.682	14.844
39	30 004.157	14.060	30 855.041	14.309	31.721 133	14.572	32.603.526	14.849
40	30 018.217	14.064	30.869.350	14.313	31.735 705	14 576	32.618.375	14.853
41	30.032.281	14 068	30 883 663	14.318	31.750.281	14.581	32.633.228	14.858
42	30 046 349	14.072	30 897 981	14 322	31.764.862	14.585	32 648.086	14.863
43	30.060 421	14.076	30.912.303	14 326	31.779 447	14.590	32 662 949	14.868
44	30.074.497	14 080	30.926 629	14.330	31.794.037	14.594	32.677.817	14.872
45	30.088.577	14 084	30 940.959	14.335	31.808.631	14.599	32 692.689	14.877
46	30.102.661	14 088	30 955.294	14.339	31.823.230	14 603	32.707.566	14.882
47	30.116.749	14 093	30.969.633	14 343	31.837 833	14 608	32.722.448	14.887
48	30.130 842	14.097	30 983.97-	14.348	31.852.441	14.612	32 737.335	14.891
49	30.144.939	14.101	30.998.324	14.352	31.867.053	14.617	32.752.22-	14 896
50	30 159.039	14.105	31.012 676	14.356	31.881.670	14.621	32 767 122	14.901
51	30.173.144	14 109	31.027.032	14.360	31.896.291	14.626	32.782.022	14.906
52	30 187.253	14.113	31.041.392	14.365	31.910 917	14.630	32 796.92-	14 911
53	30 201 366	14.117	31.055 757	14.369	31.925.547	14.635	32 811.84-	14.915
54	30 215.483	14.121	31.070.126	14 373	31.940.182	14.639	32.826 755	14.920
55	30.229.-	14.125	31.084 499	14.378	31.954.821	14.64	32.841.675	14.925
56	30.243.729	14.129	31.098.877	14.382	31.969 465	14.64-	32.856 595	14 930
57	30.257.858	14.133	31 113.259	14.386	31.984.114	14.655	32.871 525	14.935
58	30.271.991	14.138	31.127.645	14.391	31 998.767	14 65[illegible]	32.886.460	14 939
59	30.286.129	14.142	31 142.036	14.395	32 013.425	14.662	32 901 399	14.944

Min.	48 Degr. Equal parts of a Merid.	Difference of equ par.	49 Degr. Equal parts of a Merid.	Difference of equ par.	50 Degr. Equal parts of a Merid.	Difference of equ par.	51 Degr. Equal parts of a Merid.	Difference of equ par.
0	32·916·343		33 822·018		34 746·045		35 689 522	
		14·949		15·247		15·562		15·895
1	32 931 292		33·837 265		34·761 607		35 705·417	
		14·954		15·252		15·568		15·901
2	32·946 246		33·852 517		34·777·175		35·721·318	
		14·959		15·257		15·573		15 907
3	32·961 ·205		33·867·774		34 792·748		35 737 225	
		14·964		15·262		15·578		15·913
4	32·976·169		33·883 036		34·808 326		35 753·138	
		14·968		15·268		15·584		15 918
5	32 991·137		33·898·304		34·823·910		35·769 056	
		14·973		15·273		15·589		15·924
6	33·006·110		33·913·577		34·839 499		35·784 980	
		14·97		15 278		15·595		15 930
7	33·021 ·088		33·928·855		34·855·094		35·800·910	
		14·983		15 283		15 600		15 936
8	33·036·071		33 944·138		34·870 694		35·816·846	
		14·988		15·288		15 605		15 941
9	33·051·059		33·959·426		34 886·299		35·832 787	
		14 993		15 293		15·611		15 947
10	33·066·052		33·974 719		34·901·910		35·848·734	
		14 998		15·298		15·616		15·953
11	33 081 050		33·990·017		34·917·526		35·864·687	
		15 003		15·304		15·622		15·959
12	33·096 053		34 005·321		34·933·148		35·880·646	
		15·007		15 309		15 627		15 964
13	33·111·060		34·020 630		34·948·775		35 896·610	
		15·012		15·314		15·633		15·970
14	33·126·072		34·035·944		34·964·408		35·912 580	
		15·017		15·319		15 638		15·976
15	33·141 089		34·051 ·263		34·980 046		35 928 556	
		15 022		15·324		15·644		15·982
16	33 156·111		34·066·587		34·995 690		35 944·538	
		15·027		15·329		15·649		15 987
17	33 171 ·138		34 081·916		35 011·339		35 960·525	
		15·032		15·335		15·655		15·993
18	33·186·170		34 097·251		35·026·994		35·976·518	
		15·037		15·340		15·660		15·999
19	33·201·227		34·112·591		35·042·654		35 992 517	
		15·042		15 345		15 666		16·005
20	33·216·269		34·127·936		35 058·320		36 008 522	
		15 047		15·350		15 671		16·011
21	33·231 316		34·143·286		35·073·991		36 024 533	
		15·052		15 355		15·677		16·017
22	33·246 368		34·158 641		35 089·668		36·040 550	
		15·056		15·361		15 682		16·022
23	33 261·424		34·173·102		35·105 350		36·056 572	
		15·061		15 366		15 688		16·028
24	33·276·485		34·189·368		35 121 038		36 072·600	
		15·066		15·371		15·693		16 034
25	33 291·551		34·204·739		35·136 731		36·088·634	
		15·071		15 376		15·699		16·040
26	33·306 622		34 220·115		35·152·430		36·104 674	
		15·076		15 381		15·704		16·046
27	33·321·698		34·235·496		35·168·134		36·120 720	
		15·081		15·387		15·710		16 052
28	33·336·779		34·250·883		35·183 844		36·136 772	
		15·086		15 392		15 715		16·058
29	33·351·865		34 266·275		35·199·559		36·152·830	
		15 091		15 397		15·721		16·063
30	33 366·956		34·281·672		35·215·280		36·168 893	
		15 096		15·402		15·726		16·069
31	33 382·052		34·297 074		35·231 006		36·184·962	
		15·101		15·408		15·732		16·075
32	33·397·153		34·312·482		35·246·738		36·201·037	
		15·106		15·413		15 738		16·081
33	33 412·259		34·327·895		35 262·476		36 217 118	
		15 111		15 418		15·743		16·087
34	33·427·370		34·343·313		35 278·219		36 233·205	
		15·116		15·423		15 749		16·093
35	33·442·486		34 358·733		35 293·968		36 249 298	
		15·121		15·429		15·754		16·099
36	33·457·607		34 374·162		35·309 722		36 265·397	
		15 126		15·434		15·760		16·105
37	33·472·733		34·389·596		35 325·482		36·281 502	
		15·131		15 439		15 765		16·111
38	33 487·864		34·405·035		35·341 247		36·297 613	
		15·136		15·445		15·771		16·116
39	33·503·000		34·420·480		35·357·028		15·777	36·313 729
		15·141		15·450				16·122
40	33·518·141		34 435 930		35·372·805		15·782	36·329·851
		15 146		15·455				16·128
41	33·533·287		34·451 385		35·388·587		15·788	36·345·979
		15 151		15·460				16·134
42	33·548 438		34·466·845		35·404·375		15 793	36·362·113
		15·156		15·466				16 140
43	33·563·594		34·482·311		35·420·168		15 799	36·378·253
		15·161		15 471				16·146
44	33·578·755		34·487·782		35 435·967		15·805	36·394·399
		15·166		15·476				16·152
45	33·593·921		34·513·258		35·451·772		15·810	36·410 551
		15 171		15·482				16 158
46	33·609·092		34·528·740		35 467·582		15·816	36·426 709
		15·176		15 487				16·164
47	33·624·268		34 544 227		35·483·398		15 822	36·442·873
		15·181		15 492				16 170
48	33·639·449		34·559·719		35·499·220		15·827	36·459·043
		15·186		15 498				16·176
49	33·654·635		34·575 217		35 515 047		15 823	36·475·219
		15·191		15·503				16 182
50	33 669·826		34 590·720		35·530·880		15·839	36 491·401
		15·196		15·508				16 188
51	33 685·022		34·606·228		35·546·719		15·844	36·507 589
		15 201		15·514				16·194
52	33·700 223		34·621·742		35·562·563		15 850	36·523·783
		15·206		15·519				16·200
53	33·715·429		34·637·261		35·578 413		15·856	36·539·983
		15 212		15·524				16 206
54	33 730·641		34·652·785		35·594 269		15 861	36·556·189
		15·217		15·530				16·212
55	33 745·858		34 668 315		35·610·130		15·867	36 572 401
		15·222		15·535				16·218
56	33·761·080		34·683 850		35·625·997		15·873	36·588·619
		15·227		15·541				16·224
57	33·776·307		34 699·391		35 641 870		15·878	36·604 843
		15 232		15 546				16·230
58	33·791·539		34·714·937		35·657·748		15·884	36·621·073
		15 237		15 551				16·236
59	33·806·776		34 730·488		35 673·632		15·890	36 637 309
		15·242		15·557				16·242

Min.	52 Degr. Equal parts of a Merid.	Difference of equ. par.	53 Degr. Equal parts of a Merid.	Difference of equ. par	54 Degr. Equal parts of a Merid.	Difference of equ. par.	55 Degr. Equal parts of a Merid.	Difference of equ. par.
0	36.653.551	16.248	37.639.370	16 622	38.648.311	17.019	39.681.879	17.441
1	36.669.799	16.254	37 655.992	16 629	38 665 330	17.026	39.699 320	17.448
2	36.686.053	16.260	37 672.621	16.635	38 682.356	17.033	39.716.768	17.456
3	36.702.313	16.266	37.689.256	16.642	38.699 389	17.040	39.734 224	17.463
4	36 718.579	16.273	37.705.898	16.648	38 716.429	17 047	39.751.687	17 470
5	36.734.852	16.279	37.722.546	16.655	38 733.476	17.054	39.769.157	17.478
6	36 751.131	16 285	37.739.201	16 661	38.750 530	17.060	39.786.635	17 485
7	36.767 416	16.291	37.755.862	16.667	38 767 590	17.067	39.804.120	17.492
8	36.783.707	16.297	37.772 529	16.674	38.784 657	17.074	39.821.612	17.499
9	36.800.004	16.303	37 789.203	16 680	38.801 731	17.081	39.839.111	17.507
10	36.816 307	16 309	37 805.883	16 687	38.818.812	17.088	39 856.618	17.514
11	36 832.616	16.315	37.822 570	16.693	38 835.900	17.095	39.874.132	17.521
12	36.848.931	16 321	37.839.263	16.700	38.852 995	17 102	39.891.653	17 529
13	6.865.252	16.327	37.855.963	16.706	38.870.097	17 109	34.909.172	17.536
14	36.881.579	16.334	37. 72.669	16.713	38.887. 206	17.115	39.926.708	17.543
15	36 897.913	16.340	37 889.382	16.719	38.904 321	17.122	39.944.251	17.551
16	36.914 253	16 346	37.906.101	16 726	38 921.443	17.129	39 961.802	17.558
17	36 930.599	16.352	37.922 827	16.732	38 938.572	17.136	39 979 360	17.566
18	36 946.951	16 358	37 939.559	16.739	38.955 708	17.143	39 996.926	17 573
19	36 963 308	16 364	37.959 298	16.745	38.972 851	17.150	40.014 499	17.580
20	36.979 672	16 370	37 973.043	16.752	38.990 001	17 157	40.032.079	17.588
21	36 996.042	16.377	37.989.795	16.759	39.007.158	17 164	40.049.667	17.595
22	37.012 420	16.333	38.006.554	16.765	39.024.322	17.171	40 067.262	17.603
23	37 028.803	16.389	38 023.319	16 772	39.041.495	17 178	40.084.865	17.610
24	37.045.192	16 395	38 040 091	16.779	39.058 673	17.185	40.102.465	17.617
25	37.061 587	16.401	38.056 869	16.785	39 075 858	17.192	40.120.092	17.625
26	37.077.988	16.408	38.073 654	16.792	39.093 050	17 199	40.137.717	17 632
27	37.094 397	16 414	38 090.445	16 798	39 110 249	17.206	40.155.349	17.640
28	37.110 810	16.420	38.107 243	16 805	39.127.455	17.213	40.172.989	17 647
29	37.127.230	16.426	38.124.048	16 811	39.144 668	17 220	40 190.636	17.655
30	37.143.656	16 433	38.140 859	16.818	39.161.888	17 227	40 208.291	17.662
31	37.160.089	16.439	38.157 677	16.824	39 179.115	17 234	40.225 953	17 670
32	37.176.528	16.445	38.174.501	16.831	39 196.349	17.241	40 243 623	17.677
33	37 192 973	16.451	38 191 332	16.838	39 213 590	17 248	40.261.300	17.685
34	37.209.424	16 458	38.208.170	16 844	39.230.838	17.255	40.278 985	17.692
35	37 225.882	16.464	38.225 014	16 851	39 248 093	17.262	40.296.677	17 700
36	37.242.346	16.470	38 241.865	16.858	39 265.356	17.269	40.314 377	17.707
37	37 258.816	16.476	38 258.723	16 864	39.282.625	17.276	40.332.084	17.715
38	37 275.292	16.483	38.275.587	16 871	39.299 901	17.284	40.349 799	17.722
39	37.291 775	16 489	38.292.458	16 878	39 317 185	17.291	40.367 521	17 730
40	37.308.264	16.495	38.309 336	16 884	39.334.476	17.298	40.385 251	17.737
41	37.324.759	16 501	38.326 220	16.891	39.351.774	17 305	40 402.988	17 745
42	37 341.260	16.508	38.343 111	16.898	39.369.179	17.302	40.420 733	17.752
43	37.357.768	16.514	38.360.009	16. 904	39 386 401	17.3	40.438.485	17.760
44	37.374.282	16 420	38.376.913	16.911	39 403 800	17.32	40.456.245	17.768
45	37 390.802	16.527	38.393 824	16 918	39.421.126	17.332	40.474.013	17.775
46	37.407.329	16 533	38 410.742	16.925	39 438.459	17 339	40 491 788	17.783
47	37.423.862	16.539	38 427.667	16 931	39.455.799	17.346	40 509.571	17.790
48	37.440.401	16.546	38.444.598	16.948	39 473.147	17 353	40.527.361	17.798
49	37 456.947	16.55	38.461 546	16.945	39 490.502	17.362	40.545.159	17.806
50	37.473.498	16.553	38.478 491	16.501	39.507.864	17 369	40 562.965	17.813
51	37.490.057	16.560	38.495.442	16.958	39.525 233	17.376	40.580.778	17 821
52	37.506.622	16 571	38.512.470	16 965	39 542.609	17.383	40 598.599	17.829
53	37.523 193	16.578	38.529 365	16 972	39 559.992	17.391	40.616.428	17.836
54	37 539.771	16.584	38.546 337	16.979	39 577.382	17 398	40.634.264	17.844
55	37 556.355	16.590	38.563.316	16.985	39 594 781	17.405	40.652 108	17.852
56	37 572 945	16 597	38.580.301	16 992	39.612.186	17.412	40 669 960	17 859
57	37.589 542	16.603	38.597 293	16 999	39.629 598	17.420	40 687 819	17.867
58	37.606.145	16.609	38.614.292	17 006	39.647.018	17.427	40.705.686	17 875
59	37.622.754	16.616	38.631 298	17.013	39.664.445	17.434	40.723.561	17.882

Min.	56 Degr. Equal parts of a Merid.	Difference of equ. par.	57 Degr. Equal parts of a Merid.	Difference of equ. par	58 Degr. Equal parts of a Merid.	Difference of equ. par.	59 Degr. Equal parts of a Merid.	Difference of equ. par.
0	40 741·423	17·893	41·828·810	18 369	42·945·903	18·879	44·094·550	19·425
1	40 759·313	17·898	41·847 179	18·377	42·964 782	18·886	·113·975	19 434
2	40·777·211	17·906	41·865 556	18·385	42·983·676	18·897	·133·409	19·444
3	40 795·117	17 913	41·883·941	18 393	43 002·573	18·903	·152·853	19 453
4	40·813 030	17·921	41·902·334	18·402	43·021·479	18 914	·172 306	19·463
5	40·830·951	17 929	41·920·736	18 410	43·040·393	18·923	44·191·769	19·472
6	40·848 880	17·937	41·939·146	18·418	·059·316	18·932	·211·241	19·482
7	40 866·817	17·944	41·957·564	18 426	·078 248	18·941	·230·723	19·491
8	40·884·761	17·952	41·975 990	18·435	·097·189	18·950	·250 214	19·501
9	40·902·713	17·960	41·994·425	18·443	·116·139	18 959	·269·715	19·510
10	40 920·673	17·963	42·012 868	18 451	43·135·098	18·969	44 289 225	19·520
11	40·938 641	17·976	42·031·319	18·460	·154·066	18·970	·308·745	19 529
12	40·956·617	17·983	42·049·779	18 468	·173·042	18 905	·328·274	19·539
13	40·974·601	17·991	42·068·247	18·470	·192 027	18·994	·347·813	19·548
14	40·992 592	17 999	42·086·723	18·485	·211·021	19·003	·367·361	19·558
15	41·010 591	18 007	42 105 208	18·493	43·230·024	19·012	44·386·919	19·567
16	41·028·598	18 015	42·123·701	18·501	·249 036	19·021	406 486	19 577
17	41·046 613	18·023	42·142·202	18·510	·268·057	19.030	·426·063	19 586
18	41·064 63.	18 030	42 160·712	18·518	·287 097	19·039	·445 649	19 596
19	41·082 666	18 038	42·179·230	18 527	·306·146	19 049	·465·245	19 606
20	41·100·70.	18 046	42 197·757	18·535	43·325·174	19 057	44·484·851	19·819
21	41·118 750	18·054	42·216 392	18·543	·344·231	19·000	·504 466	19·625
22	41·136·804	18.062	42·234 935	18 552	·363 297	19 075	·524 091	19·635
23	41·154 866	18.070	42·253·487	18 560	·382·372	19 084	·543 726	19·644
24	41 172·936	18·078	42·272·047	18·569	·401·458	19·093	·563 370	19·654
25	41·191 014	18 086	42·290 608	18·577	43 420·551	19·102	44·583 024	19 664
26	41·209.100	18 094	42·309·185	18·586	439·653	19 111	602 686	19·673
27	41·227·194	18·102	42·327·771	18·594	·458 794	19·120	622·361	19·683
28	41·245·296	18.110	42 346·365	18·603	·477 880	19 129	·642·044	19 693
29	41·263·406	18.118	42·364 968	18·611	497 009	19·138	·661 737	19·702
30	41·281·524	18 125	42·383. 579	18·620	43·516.147	19·147	44·681·439	19 712
31	41·299·649	18 133	42 402. 199	18 629	535·294	19.156	·701·151	19·722
32	41·317·782	18·141	42·420. 827	18·637	·554 450	19·166	·720 873	19·732
33	41 335·923	18·149	42·439.464	18.645	·573·616	19·175	·740.605	19·741
34	41·354·072	18 157	42·458.109	18·654	·592·791	19 184	·760.340	19·751
35	41·372.22.	18.165	42 476.763	18.662	43·611·975	19.193	44·780 097	19·761
36	41 390 394	18.173	42 495.425	18 671	·631 168	19.202	·799 857	19·771
37	41·408 567	18.181	42·514.096	18.679	·650 370	19 211	·819 628	19 781
38	41·426.748	18.190	42·532.775	18.688	·669·581	19 220	·839.409	19·790
39	41 444.938	18 198	42·551.463	18.697	·688·801	19 230	·859.199	19·800
40	41.463·136	18 206	42.570.160	18.705	43·708 031	19 239	44 878.999	19·810
41	41·481 342	18 214	42.588.865	18.714	·727·270	19·248	·898 809	19·820
42	41·499·556	18.222	42.607.579	18 722	·746·518	19·257	·918.629	19·830
43	41·517·778	18.230	42.626.301	18.731	·765·775	19·267	·938·459	19·840
44	41·536·008	18.238	42·645·032	18·740	·785·042	19·276	·958·299	19·850
45	41·554·246	18.246	42·663·772	18·748	43·804·318	19·285	44·978·149	19·.60
46	41·572·492	18.254	42.682·520	18·757	·823·603	19·294	44 998.009	19·869
47	41·590·746	18 262	42 701·277	18·766	·842 897	19 304	45·017.878	19·879
48	41 609 008	18.270	42·720·043	18·774	·862 201	19·313	45·037·757	19·889
49	41·627·278	18·278	42·738.817	18·783	881·514	19 322	45 057.646	19·899
50	41·645·556	18.287	42·757·600	18·792	43·900·836	19·331	45·077 545	19.909
51	41·663·843	18.295	42·776·392	18.800	·920·167	19·341	·097·454	19 919
52	41 682·138	18·303	42 795·192	18.809	·939 508	19·350	·117·373	19·929
53	41·700·441	18.311	42 814·001	18.818	·958·858	19·359	·137·302	19·939
54	41·718·752	18.319	42·832.819	18 826	·978 217	19 369	·157·241	19·949
55	41·737·071	18·327	42·851·645	18·835	43·997·586	19 373	45·177·193	19·959
56	41·755·398	18 336	42·870.480	18 844	44·016·964	19·387	·197.149	19 969
57	41·773·734	18·344	42·889 324	18 853	44·036·351	19 397	·217·118	19·979
58	41·792·078	18 352	42 908·177	18.862	44 055·748	19 406	·237·097	19·989
59	41·810·430	18 360	42·927 039	18 87.	44·075·154	19·416	·257 086	20 000

60 Degr.

Min.	60 Degr. Equal parts of a Merid.	Difference of equ. par.	61 Degr. Equal parts of a Merid.	Difference of equ. par.	62 Degr. Equal parts of a Merid.	Difference of equ. par	63 Degr. Equal parts of a Merid.	Difference of equ. par.
0	45.277.105	20.010	46.495.960	20.637	47.753 849	21.312	49.053.607	22.039
1	45.297.116	20 020	46.516.597	20.648	47.775.141	21 323	49 075 646	22.052
2	45.317.130	20.030	46 537 245	20.659	47 796.464	21.335	49 097.698	22.064
3	45.337.160	20.040	46 557.9.4	20.670	47.817.799	21.347	49 119.762	22.077
4	45.357 206	20.050	46.576.574	20.686	47.839.146	21.358	49 141.839	22.089
5	45.377.251	20.060	46.599.250	20 691	17 860.504	21.370	49.163.928	22.102
6	45.397 310	20.070	46 619.941	20.70.	17 881 874	21 382	.186.030	22.115
7	45.417.380	20.080	46.640.643	20,713	47.903.256	21.394	.208.145	22.128
8	45.437.460	20.091	46.661.350	20.724	47.924.650	21 406	.230 273	22 140
9	45.457.557	20.101	46.682 080	20.735	47.946.056	21.417	.252.413	22.153
10	45.477.658	20.111	46.702.815	20.746	47.967.473	21.429	49.274.566	22 166
11	45.497.769	20.121	46 723.561	20.757	47.988.902	21.441	.296 732	22.178
12	45.517 890	20.132	46.744.318	20,768	48.010.343	21.453	.318.910	22 191
13	45.538 022	20.142	46.765.086	20,779	40 031.796	21.465	.341.101	22.204
14	45.558.164	20.152	46.785.865	20.790	48.053 201	21.476	.363.305	22.217
15	45.578.316	20 102	46.806 655	20 801	48.074.737	21.488	49 385.522	22.230
16	45.598.478	20.173	46 827.456	20.812	48.096 225	21.500	.407.752	22 243
17	45.618.651	20.163	46.849.268	20.823	46.117.725	21.512	.429 995	22.255
18	45.638 834	20.193	46.869.091	20.834	48.139.237	21 524	.452 250	22.268
19	45.659.027	20.203	46.889.925	20.845	48.160.701	21.536	.474.518	22.281
20	45.679.230	20.214	46.910.770	20.856	48.182.297	21 548	49 496.799	22 294
21	45.699.444	20.224	46.931.626	20.868	48.203.845	21.560	.519.093	22.307
22	45.719 668	20.234	46.952.494	20.879	48.225.405	21.572	.541.400	22.320
23	45.739 902	20 245	46.973.373	20.890	48.246.977	21.584	.563 720	22.333
24	45.760.147	20.255	46.994 263	20.901	48.268.561	21.596	.586.053	22.346
25	45.780.402	20 266	47.015.164	20.912	48.290.157	21.608	49.608.399	22.359
26	45.800.668	20.276	47.036 070	20.923	48.311.765	21.620	.630 758	22.372
27	45.820.944	20.286	47.056.999	20.934	48.333.385	21.632	.653.130	22.385
28	45.841 230	20.297	47.077.923	20.946	48 355.017	21.644	.675.515	22.398
29	45.861 527	20.307	47.098.870	20.957	48.376.661	21.656	.697.913	22.411
30	45.881.827	20.318	47.119.830	20.968	48.398 317	21.668	49.720.324	22.424
31	45 902 145	20.320	47.140.804	20.979	48.419.985	21.681	.742.748	22.437
32	45.922 473	20 339	47.161.783	20.991	48.441.666	21.693	.765.185	22.450
33	45.942 812	20.349	47 182 774	21.002	48.463.359	21.705	.787 635	22.464
34	45.963.161	20 360	47.203.776	21.013	48.485.064	21.717	.810.099	22.477
35	45.983.521	20 370	47.224 789	21 025	48.506.781	21 729	49.832.576	23.490
36	46.003.891	20.381	47.245 814	21.036	48.528 510	21.741	855.066	22.503
37	46.024 272	20.391	47.266.850	21.047	48.550.251	21.754	877.568	22 516
38	46.044.663	20.402	47.287.897	21.058	48.572.005	21.766	.900.084	22.529
39	46.065.065	20.412	47.308.955	21.070	48.593.771	21.778	.922 613	22 543
40	46.085.477	20.423	47.330.025	21.081	48 615 549	21 790	49 945.156	22 556
41	46.105.900	20.433	47 351.106	21.093	48.637.335	21.802	49.967.712	22 569
42	46.126.333	20.444	47.372.199	21.104	48.659.142	21.815	49.990 281	22.583
43	46.146.777	20.455	47.393.303	21.115	48.680.957	21.827	50 012.864	22 596
44	46.167.232	20.465	47.414.418	21.127	48.702.784	21 840	50.035.460	22.609
45	46.187.697	20.476	47.435.545	21.138	48.724.624	21.852	50.058.069	22.623
46	46.208.173	20.487	47.456.683	21.150	48.746.476	21.864	50.080.692	22.636
47	46.228.660	20.497	47.477.833	21.161	48.768.340	21.877	50.103 328	22 649
48	46.249.157	20.508	47.498.984	21.173	48.790.217	21 889	50.125.977	22.663
49	46.269.665	20 519	47.520.167	21.184	48.812.106	21.901	50.148.640	22.676
50	46.290 184	20.529	47.541.351	21.196	48 834.017	21.914	50.171.316	22.690
51	46.310.713	20.540	47.562 547	21.207	48.855 821	21.926	50.194.006	22.703
52	46.331.253	20 551	47.583.754	21.219	48.877.747	21.939	50.216 709	22.716
53	46.351.814	20.561	47.604 973	21.230	48.899.686	21 951	50.239.425	22.730
54	46.372.365	20.572	47.626.203	21.242	48.921.637	21.964	50 262.155	22.743
55	46.382.937	20.583	47.647.445	21.254	48.943.601	21.976	50.284.898	22.757
56	46.413.520	20.594	47.668.699	21.265	48.965.557	21.989	50 307.655	22.770
57	46.434.114	20 605	47.689.964	21.277	48.987.566	22.001	50 330.425	22.784
58	46.454.719	20.615	47.711 241	21.288	49.009.567	22 014	50.353 209	22.798
59	46.475.334	20.626	47.732.529	21.300	49.031.581	22.026	50.376 007	22.811

Min.	64 Degr. Equal parts of a Merid.	Difference of equ. par.	65 Degr. Equal parts of a Merid.	Difference of equ. par.	66 Degr. Equal parts of a Merid.	Difference of equ. par.	67 Degr. Equal parts of a merid.	Difference of equ. par.
0	50.398 818	22 825	51.793.079	23.676	53.240.555	24.602	54.745.956	25.610
1	50.421.643	22.838	51.816.755	23.691	53.265.157	24 618	54.771.566	25.628
2	50.444.461	22.852	51.840.446	23 706	53.289.775	24.634	54.797.194	25.645
3	50.467.313	22 866	51.864.152	23.721	53.314.409	24.650	54.822.839	25.663
4	50.490.179	22.879	51.887.873	23.736	53.339.059	24.666	54.848.502	25.681
5	50.513.058	22.893	51.911.609	23 750	53.363.725	24.682	54.874.183	25 698
6	50 535.951	22.907	51.935.359	23.765	53.388.407	24.698	54.899.881	25.716
7	50.558.858	22.921	51.959.124	23.780	53.413.105	24.715	54.925.597	25.734
8	50.581.779	22.934	51.982.904	23.795	53.437.820	24.731	54.951.331	25.751
9	50 604.713	22.943	52.006.699	23.810	53.462.551	24 747	54.977.082	25.769
10	50.627.661	22.962	52.030.509	23.825	53.487.298	24.764	55.002.851	25.787
11	50 650.623	22.676	52 054.334	23.840	53.512.062	24 780	55.028.638	25.805
12	50.673.599	22 990	52.078.174	23 855	53.536.842	24.796	55.054.443	25.823
13	50.696.589	23.003	52.102.029	23 870	53.561.638	24.813	55.080.266	25.841
14	50.719.592	23.017	52.125.899	23.885	53.586 451	24.829	55.106.107	25 859
15	50.742 609	23.031	52.149 784	23 900	53.611.280	24.845	55.131.966	25.877
16	50.765.660	23.045	52.173.684	23.915	53.636.125	24.802	55.157.843	25.895
17	50.788 705	23.059	52.197 593	23 931	53.660.9.7	24.879	55.183.738	25.913
18	50.811.764	23.073	52.221.530	23 946	53 685.865	24.895	55.209.651	25 931
19	50.834 837	23.087	52.245.476	23 961	53.710.760	24.911	55.235.582	25 949
20	50.857 924	23.101	52.269.437	23.976	53.735.671	24.928	55 261.531	25.967
21	50.881.025	23.115	52 293.413	23.991	53.760.599	24.944	55 287 498	25 985
22	50.904.140	23.129	52.317.404	24.006	53.785.543	24.961	55 313.483	26.003
23	50.927.269	23.143	52 341.410	24.022	53.810.514	24.978	55 339.486	26.021
24	50.950.412	23 157	52.365.432	24.037	53.835 482	24.994	55 365.507	26 039
25	50.973.569	23.171	52.389 469	24 052	53.860.476	25.011	55 391.546	26.058
26	50 996.740	23.185	52 413.521	24.068	53.885.487	25.028	55 417.604	26.076
27	51.0 9.925	23.199	52 437 589	24.083	53.910.515	25.044	55 443.680	26.004
28	51 043.124	23.214	52.461.672	24.098	53.935.559	25.061	55.469.774	26.112
29	51 066.338	23 228	52.485 770	24.114	53.960.620	25.078	55.495.886	26 131
30	51.089.566	23.242	52.509.884	24.129	53.985.698	25.095	55.522.017	26.149
31	51.112 808	23 256	52.534 013	24.145	54.010 793	25.112	55.548.166	26.168
32	51.136.064	23.270	52.558.158	24.160	54.035.905	25.128	55.574.334	26.186
33	51.159.334	23.285	52.582 318	24.175	54.061.033	25.145	55.600.520	26.204
34	51.182.619	23.299	52.606.493	24.191	54.086.178	25.162	55.626.724	26.223
35	51 205.918	23.313	52.630.684	24.206	54.111.340	25.179	55.652.947	26.241
36	51.229.233	23.327	52 654.890	24.222	54.136.519	25.196	55.679.188	26.260
37	51.252.560	23.342	52.679.112	24.238	54.161.715	25.213	55.705.448	26.278
38	51.275.902	23.356	52 703 350	24.253	54.186.928	25.230	55.731.726	26.297
39	51.299 258	23.270	52.727.603	24.269	54 212.158	25.247	55.758.023	26.316
40	51.322.628	23.385	52 751.872	24.284	54.237.405	25 264	55.784.339	26.334
41	51 346 013	23 399	52.776.156	24.300	54.262.669	25.281	55.810.670	26.353
42	51.369 41.	23 414	52 800.456	24.316	54.287.950	25.298	55.837.026	26 372
43	51.392.826	23.42	52.824.772	24.331	54.313 248	25.315	55.863.398	26.390
44	51 416.254	23.442	52.849.103	24.347	54.338.563	25.332	55.889.788	26.409
45	51.439.696	23 457	52.873.450	24.363	54.363.895	25 350	55.916.197	26.428
46	51.463.153	23.471	52.897.813	24.379	54.389.245	25.367	55.942.625	26.447
47	51.486 624	23.486	52 922.192	24.394	54.414.612	25.384	55.969 072	26.466
48	51 510.110	23.500	52.946.586	24.410	54.439.996	25.401	55.995.538	26.485
49	51 533 612	23 515	52.970.996	24.426	54.465 397	25.41.	56 022.023	26.503
50	51.557.125	23.529	52.995.422	24.442	54.490.815	25.436	56 048.526	26.522
51	51 580.654	23.544	53.019.864	24.458	54.516.251	25.453	56.075.048	26.541
52	51 604.198	23 559	53.044.322	24.474	54.541.704	25.470	56.101 589	26.560
53	51.627.757	23.573	53.068.796	24.489	54.567.174	25.488	56.128.149	26.579
54	51.651.330	23.588	53 093 285	24.505	54 592.662	25.505	56.154.728	26.598
55	51.674.918	23 603	53.117.790	24.521	54.618.167	25.523	56.181 326	26 618
56	51.698.521	23 617	53.142.311	24.537	54.643.690	25.540	56.207 944	26.637
57	51.722.138	23.632	53.166.848	24.553	54.669.230	25.558	56.234 581	26.656
58	51.745.770	23 647	53.191.401	24 569	54.694.788	25.575	56.261.237	26.675
59	51.769.417	23.662	53.215.970	24 585	54 720.363	25 593	56.287.912	26 694

Min.	68 Degr. Equal parts of a Merid.	Difference of equ. par.	69 Degr. Equal parts of a Merid.	Difference of equ. par.	70 Degr. Equal parts of a Merid.	Difference of equ. par.	71 Degr. Equal parts of a Merid.	Difference of equ. par.
0	56·314·606		57·952·571		59·666·811		61·465·263	
		26·713		27·925		29·261		30 741
1	56 341 319		57 980 496		59·696·072		61·496·004	
		26 733		27·946		29·284		30·767
2	56·368·052		58·008 442		59·725 356		61·526·771	
		26·752		27·967		29·308		30·793
3	56·394·804		58·036·409		59·754·664		61·557·564	
		26·771		27 989		29 331		30·819
4	56 421·575		58·064·398		59 782·995		61·588·383	
		26·791		28·010		29 355		30845
5	56·448·366				59·81 350		61·619·228	
		26·810	58·092·408	28·031	59·842·728	29·378	61 650·100	30 872
6	56·475·176		58·120·439			29 402		
		26·829		28 053	59·872·130		61·680 998	30·898
7	56·502 005		58·148·492			29·426		30·924
		26 849		28·074	59·901·556		61·711·922	
8	56·528 854		58 176·566			29·449		30·950
		26·868		28·095	59·931·015		61·742·872	
9	56 555 722		58 204·661			29·473		30 977
		26·888		28·117				
10	56·582·610				59·960·488		61·773·849	
		26·907	58 232·778	28·138		29·497		31·003
11	50·609·517		58 260 916		59 989·985		61 804 852	
		26·927		28·160		29 521		31·030
12	56·636·444		58·289 076		60·019·506		61 835·882	
		26·947		28·182		29 545		31·056
13	56 663 391		58·317·258		60 049·051		61·866·938	
		26 966		28 203		29·569		31 083
14	56·690·357		58·345·461		60·078·620		61 898·021	
		26·986		28·225		29·593		31·110
15	56·717 343				60·108·213		61·929 131	
		27·006	58·373·686	28·247		29·617		31·136
16	56·744·349		58·401·933		60·137·830		61·960·267	
		27·025		28·26		29 641		31·163
17	56·771·374		58·430·201		60·167 471		61·991·430	
		27·045		28·290		29 665		31·190
18	56 7 8 419		58·458 491		60·197·136		62·022 620	
		27·065		28·312		29·689		31·217
19	56·825·484		58·486 803		60·220·825		62·053 837	
		27 085		28·334		29 713		31·243
20	56·852 569				60·256·538		62·085 080	
		27·104	58·515·137	28·356		29 737		31·270
21	56·879 673		58·543·493		60·286·275		62 110·350	
		27·124		28·377		29·761		31·297
22	56·906·797		58·571 870		60·316·036		62 147·647	
		27·144		28·39		29 786		31·324
23	56·933 941		58 600·269		60·345·822		62·178·971	
		27·164		28·421		29 810		31·351
24	56·961 105		58 628·690		60·375·632		62 210·322	
		27·184		28·443		29·834		31·379
25	56·988·289		58·657·133		60·405 466		62·241 701	
		27·204		28·465		29·859		31 406
26	57·015 493		58 685 598		60·435·325		62·273·097	
		27·224		28·488		29·883		31·433
27	57·042·717		58·714 086		60·465 208		62·304 540	
		27 244		28·510		29 908		31·460
28	57 069·961		58·742·596		60 495·116		62·336 000	
		27·264		28·532		29 932		31·488
29	57·097·225		58·771·128		60·525·048		62 367·488	
		27·285		28 554		29 957		31·515
30	57·124·510		58 799·682		60·555 005		62·399·003	
		27·305		28·576		29·982		31·542
31	57·151·815		58·028·268		60 584·987		62·430·545	
		27·325		28·599		30·006		31·570
32	37·179·140		58·856 857		60·614·993		62·462·115	
		27 345		28 621		30·031		31·597
33	57·206·485		58·885 478		60·645 024		62·493·712	
		27 365		28·643		30 056		31·625
34	57·233 850		58 914·121		60·675 080		62·525 337	
		27·386		28·666		30·081		31 653
35	57·261·236		58·942·787		60·705·161		62·556·990	
		27·406		28·688		30 105		31·680
36	57·288·642		58·971·475		60·735·266		62·588·670	
		27·426		28·710		30·130		31·708
37	57·316 068		59·000·185		60·765·396		62·620·378	
		27·447		28 733		30·155		31·736
38	57·343·515		59 028·918		60·795·551		62·652·114	
		27·467		28·755		30 180		31·764
39	57·370 982		59·057·673		60·825·731		62·683 874	
		27·488		28·778		30 205		31 791
40	57·398·470				60·855·936		62 715 669	
		27·508	59·086·451	28·801		30·230		31 819
41	57·425·978		59·115·252		60·886·166		62·747 478	
		27·52		28·823		30 255		31·847
42	57·453·507		59·144·075		60·916 421		62 779·335	
		27·545		28·846		30 281		31 875
43	57·481·056		59·172 921		60·946·702		62·811·210	
		27·570		28·869		30 306		31·904
44	57·508·626		59·201 790		60·977 008		62·843·114	
		27·590		28·891		30·331		31·932
45	57·536·216				61·007 339		62·875·046	
		27·611	59·230·681	28·914		30·356		31·969
46	57·563·827		59·259·595		61·037 695		62 907·006	
		27·632		28·937		30·382		31·988
47	57 591·459		59·288·532		61·068·077		62·938·994	
		27·652		28·960		30 407		32·016
48	57·619·111		59 317·492		61·098·484		62·971·010	
		27·672		28·983		30 432		32·043
49	57 646·784		59 346·475		61·128·916		63 003 055	
		27·692		29 006		30·458		32·073
50	57·674·478				61·159 374		63·035·128	
		27·715	59·375·481	29·029		30·483		32·102
51	57·702·193		59·404·510		61·189·857		63·067·230	
		27·736		29·052		30 509		32·130
52	57·729 929		59·433 562		61·220 366		63·099·360	
		27 757		29·075		30 535		32·159
53	57·757 686		59·462·637		61·250·901		63·131·519	
		27·778		29·098		30·560		32·187
54	57·785 464		59·491·735		61 281·461		63·163·706	
		27·798		29 121		30·586		32·216
55	57·813·262		59·520·856		61·311·947		63·195·922	
		27·819		29·144		30·612		32·245
56	57·841·081		59 550·000		61·342·559		63 228·167	
		27 841		29·168		30·637		32·274
57	57 868·922		59·579·168		61·373·196		63·260 441	
		27·862		29 191		30·663		32 302
58	57·836 784		59·608·359		61·403·859		63·292·743	
		27·883		29·214		30·689		32·331
59	57 924 667		59·637·573		61·434·548		63·325·074	
		27·904		29·238		30·715		32·360

72 Degr

Min.	72 Degr. Equal parts of a Merid.	Difference of equ par.	73 Degr. Equal parts of a Merid.	Difference of equ. par.	74 Degr. Equal parts of a Merid.	Difference of equ. par.	75 Degr. Equal parts of a Merid.	Difference of equ. par.
0	63·357·434	32·389	65·354·167	34·235	67·468·373	36·316	69·715·485	38·679
1	63 389 823	32·418	65·388·402	34·268	67·504·694	36 353	69·754 164	38·721
2	63 422 241	32·447	65·422·670	34·300	67·541·047	36·390	69·792 885	38·763
3	63·454·688	32·477	65·456 970	34·333	67 577·437	36 427	69·831·648	38·805
4	63·487·165	32·506	65·491·303	34·366	67·613 864	36·464	69·870 453	38·847
5	63·519·671	32·535	65·525·663	34·399	67·650 328	36·501	69·909·300	38·890
6	63·552 206	32·564	65 560·068	34·432	67·723·368	36 539	69·948 190	38·932
7	63·584·770	32·594	65 594·500	34·465	67 759·944	36 576	69·987·142	38 975
8	63 617·364	32 623	65·628·965	34·498	67·796·557	36 613	70·026·117	39·018
9	63 649·987	32 653	65·663·463	34·531	67 833·208	36 651	70·065 135	39·061
10	63·682·640	32 682	65·697·994	34·564	67·869·897	36·689	70 104·196	39·104
11	63·715·322	32·712	65·732·558	34·598	67 906 623	36 726	70·143·300	39·147
12	63·748·034	32·741	65·767 150	34·631	67·943 387	36·764	70·182·447	39 190
13	63 780·775	32·771	65 801 7.7	34 665	67·980·189	36·802	70·221·637	39 233
14	63·813·546	32·801	65·836·452	34 698		36·840	70 260 870	39·277
15	63·846·347	32·831	65 871·150	34 732	68 017·029	36·878	70·300·147	39·320
16	63 879·178	32·861	65·905·882	34 765	68·053·907	36·916	70 339·467	39·363
17	63 912·039	32·891	65·940 647	34 799	68 090·823	36·954	70 378·830	39 407
18	63 944·930	32·921	65 975·446	34 833	68 127 777	36·993	70·418 237	39·451
19	63·977·851	32·951	66 010 279	34·867	68 164·770	37 031	70·457·688	39 495
20	64 010·802	32 981	66·045 146	34 901	68 201·801	37·069	70·497·183	39·539
21	64·043 783	33·011	66·080·047	34 935	68·238 870	37·108	70·536·722	39·583
22	·076 794	33 041	66·114 982	34 969	68 275 978	37 147	70·576 305	39 627
23	·109·835	33 072	66·149·951	35 003	68 313·125	37·185	70·615 932	39·671
24	·142·907	33 102	66·184·954	35 037	68 350 310	37·224	70·655 603	39 715
25	64·176 009	33·132	66·219·991	35·071	68 387 534	37·263	70·695·318	39·760
26	·209 141	33·163	66·255 002	35·105	68 424·797	37·302	70·735 078	39·804
27	·242·304	33 193	66·290·107	35·140	68·462 099	37·341	70·774 882	39·849
28	·275·497	33·224	66·325·307	35·174	68·499·440	37 380	70 814·731	39·894
29	·308·721	33·255	66 360·481	35·209	68·536·820	37·419	70 854·625	39·939
30	64·341·976	33·285	66·395·690	35 243	68 574·239	37·459	70 894·564	39·984
31	·375·261	33 316	66 430 933	35·278	68·611·698	37 490	70 934·548	40·029
32	·408 577	33·347	66·466 211	35·313	68 649·196	37 537	70 974·577	40·074
33	·441·924	33·370	66 501·524	35·348	68·686·733	37·577	71 014·651	40·119
34	·475 302	33·402	66·536·872	35·383	68·724 310	37 617	71 054·770	40·165
35	64·508·711	33·440	66·572 255	35·418	68·761·927	37·656	71·099·935	40·210
36	·542·171	33 471	66·607 673	35 453	68 799 583	37·696	71·135·145	40·256
37	·575 622	33 502	66 643·126	35·488	68·837·279	37 736	71·175·401	40 302
38	·609 124	33·533	66 678 614	35 523	68·874·915	37·776	71·215·703	40 347
39	·642·657	33 564	66·714·137	35·558	68·912 791	37·816	71·256 051	40 393
40	64·676·221	33·594	66·748·695	35·594	68 950 607	37 856	71·296·444	40·439
41	·709 817	33 627	66·785 269	35 629	68·988 463	37·897	71·336·883	40 485
42	743·444	33 650	66·820·918	35 664	69 026·360	37 937	71 377·358	40 532
43	·777·102	33 690	66·856·582	35·700	69·064 297	37·977	71 417·900	40·578
44	·810 792	33·722	66 892·282	35·736	69·102 274	38·018	71 458 478	40 625
45	64 844·514	33 753	66·928·018	35·771	69 140·292	38 058	71·499·103	40·671
46	878·267	33 785	66·963 789	35·807	69 178·350	38·099	71 53··774	40·718
47	·912·052	33·817	66 999·596	35 843	69·216 443	38·140	71 580·472	40·765
48	·945·869	33·848	67 035·439	35·879	69·254 589	38 181	71·621 257	40·812
49	64·979 717	33·880	67·071 318	35 915	69·292 770	38 222	71·662·086	40·859
50	65·013·597	33·91	67·107·233	35·951	69·330·992	38·263	71 702 92.	40·906
51	65·047 509	33·94	67 143·184	35·987	69 369·255	38·304	71 743·034	40·953
52	65·081·453	33 97	67 179·171	36·023	69·407 559	38·345	71·704 787	41·000
53	65·115·429	34·000	67 215·194	36·060	69·445 904	38·387	71 825·787	41 048
54	65·149·437	34·031	67·251 254	36 096	69 484 291	38 428	71·666 835	41·095
55	65 183·478	34 073	67·287·350	36·132	69·522 719	38·470	71 907 930	41 143
56	65·217 551	34 105	67·323 482	36·169	69·561·189	38·511	71·950·073	41·191
57	65 251 656	34·136	67 359 651	36·205	69 599 700	38·553	71·990·264	41 239
58	65·285 794	34·170	67·395 857	36·242	69·638·253	38·595	72 031 503	41·287
59	65 319·964	34 2 2	67 432·099	36·279	69·676·848	38 637	72 072 790	41 335

76 Degr.

Min.	76 Degr. Equal parts of a Merid.	Difference of equ. par	77 Degr. Equal parts of a Merid	Difference of equ. pa:	78 Degr. Equal parts of a Merid.	Difference of equ. pa	79 Degr. Equal parts of a Merid	Difference of equ. par.
0	72 114 125	41 383	74 687·014	44 510	77·462·411	48.163	80.475·935	52.436
1	72 155·508	41 432	74 731·524	44·566	77·510·574	48.229	80·523·421	52·505
2	72 196 940	41 480	74 776·090	44·622	77·558·803	48.295	80·560·986	52·565
3	72·238·420	41 529	74·820 712	44 679	77·607·098	48·362	80·633·651	52·634
4	72·279·949	41·578	74·865·391	44·755	77·655·460	48.428	80.686·354	52·702
5	72·321·527	41·627	74 910·126	44·792	77·703·888	48·495	80·739·156	52·773
6	72·363·154	41·676	74·954·918	44 849	77·752·383	48·562	80·792·043	52·843
7	72·404·830	41 725	74·999·767	44·906	77·800·945	48·629	80·845·003	52·913
8	72 446 555	41 774	75 044·673	44 964	77·849 574	48·697	80·898·036	52·983
9	72·488·329	41 823	75·089·637	45·021	77·898 271	48·765	80·951·170	53·054
10	72·530·152	41·873	75·134·658	45·079	77·947·035	48·832	81·004·374	53 285
11	72·572·025	41 922	75 179 737	45·136	77·995·867	48·900	81·057·669	53·367
12	72·613·947	41·972	75·224·873	45·194	78·044·767	48·968	81·111·026	53·446
13	72 655·919	42 022	75·270 067	45 252	78·093·735	49·037	81·164·474	53·530
14	72·697·941	42·072	75·315·319	45·310	78·142·772	49·105	81·218·024	53 612
15	72 740 013	42·122	75·360·629	45·369	78 191·877	49·174	81·271·616	53 694
16	72·782·135	42·172	75·405 998	45·427	78·241·051	49·243	81·325·310	53·777
17	72·824·307	42·222	75 451·425	45 486	78·290·294	49·312	81·379·087	53·859
18	72·866 529	42·273	75 496 911	45·545	78·339·606	49·382	81·432·946	53·943
19	72·908·802	42·323	75 542 456	45 604	78·388·988	49 451	81·486·889	54·025
20	72·951·125	42 374	75·588·060	45·663	78·438·439	49·521	81·540·915	54·109
21	72·993·499	42·425	75·633·723	45 722	78 487·960	49·591	81·595·024	54 193
22	73 035·924	42·476	75·679·445	45 781	78·537·551	49·661	81·649·217	54 277
23	73 078·400	42·527	75·725 226	45·841	78·587·212	49·731	81·703·494	54 362
24	73·120 927	42·578	75·771·067	45·901	78·636·943	49·802	81·757·856	54 446
25	73 163·505	42·629	75 816·968	45 961	78·686·745	49·873	81·812·302	54 531
26	73·206·134	42·681	75·862 929	46 021	78·736·618	49·94	81·866 833	54·616
27	73 248·815	42·732	75 908·950	46·081	78·786 562	50·015	81·921 449	54·702
28	73·291·547	42 784	75 955·031	46·141	78·836·577	50·086	81·976 151	54·788
29	73·334 331	42·835	76·001 172	46·202	78·886·663	50·158	82·030 939	54·874
30	73·377 167	42 888	76·047·374	46·262	78·936·821	50·230	82·085·813	54·960
31	73·420·055	42 940	76·093·636	46 323	78·987·051	50·302	82·140 773	55 046
32	73·462·995	42·992	76 139·959	46·384	79·037·353	50·374	82·195 819	55·133
33	73 505·987	43·045	76 186·343	46·446	79·087·727	50·447	82·250·953	55·220
34	73·549·032	43 097	76·232·789	46 507	79·138·174	50·519	82·306 172	55 306
35	73·592 129	43·150	76·279·296	46·561	79·188·693	50·592	82·361 480	55 393
36	73 635·279	43 202	76·325·864	46·630	79·239·285	50·665	82·416·875	55 480
37	73·678 482	43 255	76 372 494	46·692	79·289·950	50·739	82·472·358	55 567
38	73·721 737	43 309	76·419 186	46·754	79·340·689	50·812	82·527 929	55 654
39	73·765·046	43·362	76·465·940	46·816	79·391·501	50·886	82·583·587	55 749
40	73 808·408	43 415	76·512·756	46·879	79·442·387	50·960	82 639·338	55·828
41	73·851 823	43·469	76·559·635	46 941	79·493·347	51·034	82·695 176	55·927
42	73·895·291	43·522	76·606·576	47·004	79·544·381	51·108	82·751·103	56·016
43	73·938 813	43 576	76·653·580	47·067	79·595·489	51·183	82 807 122	56·105
44	73·982·389	43 629	76·700·647	47 130	79·646·672	51·258	82·863·227	56·195
45	74·026·018	43·683	76·747·777	47 193	79·697·930	51·333	82·919·424	56 285
46	74·069 701	43·738	76·794·970	47·256	79·749·263	51·408	82 975·712	56 376
47	74·113·439	43 792	76·842 226	47·320	79 800·671	51·484	83·032·090	56·467
48	74·157 231	43·846	76·889·546	47 384	79·852·155	51·559	83·088 560	56·562
49	74 201·077	43·901	76 936·930	47 448	79·903·714	51·635	83 145 121	56·655
50	74·244·978	43·955	76·984·378	47 512	79 955·349	51·712	83 201 774	56·748
51	74·288 933	44 010	77 031·890	47·576	80.007·061	51·788	83 258 519	56 842
52	74 332·943	44 065	77·079·466	47 641	80.058·849	51·865	83 315·356	56·936
53	74 377 008	44·120	77·127 107	47 705	80.110·714	51·942	83·372·286	57·031
54	74·421 128	44·175	77·174 812	47·770	80·162·656	52·019	83·429 309	57·126
55	74 465·303	44·231	77·222·582	47 835	80.214·675	52·096	83 486 425	57·221
56	74·509·534	44·286	77 270·417	47·900	80.266·771	52·174	83·543·634	57 317
57	74·553·822	44·342	77·318·317	47 966	80·318·945	52·252	83 600·939	57·413
58	74 598·162	44 398	77·366·283	48·031	80·371·197	52·330	83 658 337	57 508
59	74·642·566	44 454	77·414·314	48·097	80·423·527	52·408	83 715·829	57·604

Min	80 Degr. Equal parts of a Merid.	Difference of equ. par.	81 Degr. Equal parts of a Merid.	Difference of equ. par.	82 Degr. Equal parts of a Merid.	Difference of equ. par.	83 Degr Equal parts of a Meid.	Difference of equ. par.
0	83·773·416	57 682	87·415·219	64 042	91·483·111	72·001	96 091·773	82·249
1	83·831·098	57·778	87·479 261	64·160	91·555·113	72·151	96·174·022	82·445
2	83·888·876	57·874	87 543·421	64 278	91 627·264	72·301	96·256 467	82·642
3	83·946·750	57·970	87·607·699	64·397	91·699·565	72 452	96·339 003	82·840
4	84 004 720	58 066	87·672·096	64·517	91·772 017	72·604	96·421·949	83 038
5	84·062·786	58·163	87 736 613	64·636	91 844·621	72·756	96·504·987	83 238
6	84·120·949	58·260	87 801·249	64·757	91·917 377	72 909	96·588 225	83·439
7	84 179 209	58 358	87·866·006	64·877	91·990·286	73·062	96·671 664	83 640
8	84·237·567	58 455	87 930·883	64·999	92·063·348	73·217	96·755 304	83·843
	84·296·022	58 553	87·995·882	65·120	92·136·565	73·371	96·839·147	84·046
10	84·354·575	58·652	88·061·002	65·242	92·209 936	73·527	96·923·193	84·251
11	84·413·227	58·751	88·126 244	65·365	92·283 463	73·683	97·007 444	84·456
12	84·471·978	58 850	88·191·609	65·488	92 357·146	73·840	97 ·091·900	84·663
13	84·530 828	58 949	88·257·097	65·612	92 430·986	73·997	97·176·563	84·870
14	84 589·777	59 049	88·322·709	65·736	92·504 983	74·155	97·261·433	85·079
15	84·648·826	59·149	88·388·445	65 860	92 579·138	74·314	97·346 512	85·288
16	84·707 975	59·250	88·454·305	65·981	92·653·452	74 474	97·431·800	85·499
17	84·767·225	59 350	88·520 290	66 110	92 727·926	74·634	97·517·299	85·711
18	84·826·575	59·452	88·586 400	66·236	92 802·560	74·795	97·603·010	85·924
19	84·886 027	59·553	88 652·636	66 363	92·877·355	74·957	97·688·934	86 137
20	84·945 580	59·655	88·718·999	66·490	92·952·312	75·119	97·775·071	86·352
21	85·005·235	59 757	88 785·489	66·617	93·027·431	75·282	97·861·423	86·568
22	85·064·992	59·860	88·852·106	66 745	93·102·713	75·446	97·947·991	86·785
23	85·124 852	59·963	88 918·851	66·873	93·178·159	75·610	98·034·776	87 004
24	85·184·815	60 066	88·985·724	67 002	93·253·769	75 775	98·121 780	87·223
25	85·244·881	60·170	89·052·726	67·132	93·329·544	75·941	98 209·003	87·443
26	85·305·051	60·274	89 119·858	67·261	93·405 485	76 108	98·296·446	87·665
27	85·365 325	60 378	89·187·110	67·392	93·481·593	76·275	98·384·111	87·887
28	85·425 703	60 483	89·254·511	67·522	93·557 868	76·444	98 471·998	88·111
29	85·486·186	60 588	89·322·034	67·654	93·634·312	76·612	98·560·109	88·336
30	85·546·774	60·694	89·389 688	67·786	93·710·914	76·782	98·648·445	88·562
31	85·607·468	60 799	89·457·474	67·919	93·787·706	76·953	98·737·007	88·790
32	85·668·267	60·906	89·525·393	68·052	93·864·659	77·124	98·825 797	89·018
33	85·729·173	61·012	89·593·445	68.185	93·941·783	77·296	98·914·815	89·248
34	85·790·185	61·119	89·661 630	68·319	94·019·079	77·468	99·004·063	89·479
35	85·851·304	61·227	89·729 749	68·454	94 096·547	77·642	99·093·542	89·711
36	85·912·531	61·335	89·798·403	68·589	94 174·189	77·816	99·183·253	89 944
37	85·973·866	61·443	89·866·992	68·724	94·252·005	77·991	99·273·197	90 178
38	86 035 209	61·551	89·935·716	68·861	94·329·996	78 167	99·363·375	90·414
39	86·096·860	61·660	90·004·577	68 997	94·408·163	78·344	99·453·789	90·651
40	86·158 520	61·770	90·073·574	69·135	94·486·507	78·521	99·544·440	90 889
41	86·220·290	61·879	90 142·709	69·273	94·565·028	78 700	99·635 329	91·129
42	86·282·169	61 989	90·211 982	69·411	94·643·728	78·879	99·726 458	91·369
43	86·344 158	62·100	90·281·393	69·550	94 722 607	79·059	99·817 827	91·611
44	86·406·258	62·211	90·350 943	69.689	94·801·666	79 239	99·909·438	91 855
45	86.468·469	62·322	90·420·632	69·830	94·880·905	79·421	100.001·293	92·099
46	86·530 791	62·434	90 430·462	69 970	94·960·326	79·603	100.093·392	92·345
47	86·593·225	62·546	90·560·432	70·111	95·039 929	79·787	100 185·737	92·593
48	86 655·771	62·658	90·630·543	70 253	95·119·716	79·971	100.278.330	92·841
49	86·718·429	62 771	90·700·796	70·396	95·199·687	80 156	100.371.171	93·091
50	86·781 200	62·885	90·771·192	70·539	95·279·843	80·342	100.464 262	93·342
51	86 844·085	62·999	90·841 731	70·682	95·360·185	80 529	100 557.604	93·595
52	86·907·084	63·113	90 912·413	70·826	95·440·714	80·716	100.651.190	93 849
53	86·970·197	63·227	90·983·239	70·971	95 521·430	80·905	100.745 048	94 105
54	87·033·424	63·342	91·054 210	71·117	95·602·335	81·094	100 839.153	94·361
55	87·096·766	63·458	91·125·327	71·263	95·683 429	81 284	100 933.514	94 620
56	87·160·224	63·574	91·196 590	71 409	95·764·713	81·476	101.028 134	94·879
57	87·223·798	63·690	91 267·999	71·556	95·846·189	81·668	101.123 013	95·141
58	87 287·488	63·807	91·339·555	71·704	95·927·857	81·861	101.218 154	95·403
59	87·351·295	63·924	91 411·159	71·852	96·009·718	82 055	101 313·557	95·667

Min.	84 Degr. Equal parts of a Merid.	Difference of equ. par.	85 Degr. Equal parts of a Merid.	Difference of equ.par.	86 Degr. Equal parts of a Merid.	Difference of equ. par.	87 Degr. Equal parts of a Merid.	Difference of equ. par.
0	101 409.224		107.696.200	115 119	115 389.469	143.954	125 209.226	192.139
1	101.505.157	95.933	107.811 319	115.505	115 533.423	144.558	125.401.365	193.218
2	101.601.357	96.200	107.926.824	115.893	115.677.901	145.167	125.594.583	194.308
3	101 697.825	96 468	108.042.717	116.283	115.823.148	145.781	125 788.891	195 411
4	101.794.563	96.738	108.159.002	116.676	115.968.929	146.401	125.984.102	196.527
5	101.891.573	97.010	108 275.678	117.072	116.115.330	147.025	126.180 829	197 656
6	101.988.856	97.283	108.392 750	117 471	116.262.355	147.655	126.378.485	198.797
7	102.086.413	97.557	108 510.221	117.872	116.410.010	148.291	126.577.282	199.952
8	102.184.247	97.834	108.628.093	118 276	116.558 001	148.932	126.777 234	201.120
9	102.282.358	98.111	108.746.369	118 683	116.707.233	149.578	126.978 354	202.302
10	102.380.749	98.391	108.865.052	119.093	116.856 811	150.230	127.180 656	203.498
11	102.479.421	98.672	108 984.145	119.506	117.007 041	150.888	127.384 154	204.709
12	102.578.375	98 954	109.103 651	119 921	117.157.92	151.552	127.588 853	205.934
13	102.677 613	99.238	109 223.572	120 339	117 309 461	152.222	127.794 797	207.173
14	102.777.137	99 524	109.343 911	120.760	117.461.703	152.897	128.001.970	208.428
15	102 876 949	99.812	109.464.671	121.185	117.614.607	153.579	128.210.398	209.698
16	102 977.050	100 101	109 585.856	121.612	117 768.17	154.267	128 420 096	210 983
17	103.077.442	100.392	109.707.468	122.042	17 622 44	154.961	128 631.079	212 285
18	103.178.126	100.684	109 829.510	122.476	118.077 407	1 5.661	128 843.364	213.602
19	103.279.105	100 979	109.951.986	122 912	118 233.068	156.367	129.056 960	214.936
20	103 380.380	101.275	110.074.898	123 352	118.389.435	157.080	129.271.902	216.287
21	103.481.952	101.572	110.198.250	123.794	118 546.515	157.800	129 488 189	217.655
22	103.583 824	101 672	110 322.044	124.240	118.704 315	158 526	129 705 844	219.040
23	103.685.997	102.173	110.445.628	124 989	118.862 841	159.259	129.924.884	220.444
24	103 788 473	102.476	110.570.973	125 142	119.022 100	159.999	130.145 328	221.865
25	103.891.254	102 781	110 696.115	125.598	119.182 099	160.746	130 367.193	223.304
26	103.994.342	103.088	110.821.713	126.057	119.342 845	161.499	130 590.497	224.763
27	104.097 739	103 397	110.947.770	126 519	119.504.344	162.260	130 815.260	226 241
28	104 201.446	103 707	111 074 289	126.985	119 666.604	163.020	131.041.501	227.738
29	104.305.465	104 019	111 201.274	127 454	119.829.632	163.804	131 269 239	229.255
30	104.409.799	104 334	111.328.728	127.927	119.993.436	164.586	131.498.494	230.793
31	104.514 449	104.650	111.456.655	128 404	120.158 022	165.377	131.729.287	232 351
32	104 619 417	104.968	111 585.059	128 884	120.323.399	166.175	131.561 638	233.936
33	104.724 705	105.288	111 713.943	129.367	120.489.574	166.986	132 195 574	235 532
34	104.830.315	105.610	111.843 310	129.854	120 656.554	167 794	132 431.106	237.156
35	104.936.249	105.934	111.973.164	130.345	120 824 348	168.615	132.668.262	238.802
36	105.042.509	106.260	112 103.509	130.840	120.992.963	169 441	132 907 064	240.470
37	105.149.097	106.588	112.234.349	131.338	121.162 403	170.283	133 147 534	242.163
38	105.256.015	106 918	112.365 687	131 841	121.332.691	171.124	133.389 697	243.880
39	105 363.265	107.250	112.497 528	132.347	121.503.820	171 984	133.633.577	245.621
40	105.470.849	107.584	112.629.875	132 857	121 675 804	172.847	133 879 19	247.387
41	105.578 770	107.921	112.762 732	133.371	121.848.651	173.719	134.126.585	249.178
42	105 687.029	108.259	112.895 803	133.889	122 022.370	174.600	134.375.703	250.996
43	105.795.629	108.600	113.029 992	134.411	122.196 970	175.480	134 626 759	252.841
44	105 904 571	108 942	113.164.403	134 937	122 372.466	176.389	134.879.660	254 713
45	106.013.858	109 287	113.299 340	135 467	122 548.849	177 297	135.134.313	256.613
46	106 123 492	109.634	113.434 807	136.002	122.726.146	178.215	135.390 926	258 541
47	106.233.476	109.984	113.570.809	136.540	122.904.361	179.142	135.649.467	260.492
48	106.343.811	110.335	113 707.349	137.083	123.083.503	180 078	135.909.966	262.486
49	106 454.500	110.689	113.844 432	137 631	123.263 581	181.025	136.172.452	264.505
50	106 565 545	111 045	113.982 063	138.183	123 444.608	181 983	136 436.957	266.554
51	106.676.948	111.403	114.120 246	138.739	123.626.589	182 95	136 703.511	268.636
52	106.788 713	111.764	114.258 685	139 299	123 809.539	183 927	136 972.147	270.750
53	106.900.839	112.127	114 398.284	139 865	123.993.466	184.915	137.242 897	272 898
54	107.013.332	112 493	114.538.149	140 435	124 078 381	185.913	137 515.795	275 080
55	107.126.193	112 861	114 678.584	141 009	124 264.294	186.923	137 790 87	277 277
56	107.239.424	113.231	114 819.592	141 588	124.451.217	187.943	138 068.17	279.551
57	107.353 128	113.604	114.961.181	142.172	124 639 160	188.975	138.347.722	281.841
58	107 467.107	113.979	115.103 353	142 761	124.828 135	190 018	138 629 564	284.169
59	107 581.463	114.356	115.246.114	143 355	125.018.153	191 073	138 913 733	286 537

Min.	88 Degr. Equal parts of a Merid.	Difference of equ. par.	89 Degr. Equal parts of a Merid.	Difference of equ. par.
0	139.200.270		163.175.324	
		288.943		582.696
1	139.489 213		163.758.020	
		291.301		592.743
2	139.780.604		164.350 763	
		293.881		603.141
3	140.074.485		164.953.904	
		296.413		613.910
4	140 370 898		165.567 814	
		298.990		625 071
5	140 669.888		166.192.885	
		301.612		636.645
6	140.971.500		166.829.530	
		304.281		648.657
7	141.275.781		167.478 187	
		306.995		661.130
8	141 582.776		168.139.317	
		309.760		674 092
9	141.892.536		168.813.409	
		312.575		687 573
10	142.205 111		169.500.982	
		315.442		701.604
11	142 520.553		170.202.586	
		318.361		716.220
12	142.838.914		170.918 806	
		321.336		731.458
13	143 160.250		171.650.264	
		324.367		747 358
14	143.484.617		172.397.622	
		327.455		763.965
15	143 812 072		173.161 587	
		330.602		781.327
16	144 142 674		173 942.914	
		333.811		799.496
17	144.476 485		174 742.410	
		337.083		818.531
18	144.813.568		175.560.941	
		340.419		838.494
19	145.153.987		176.399.435	
		343.823		859.456
20	145.497.810		177.258.891	
		347 295		881.492
21	145.845.105		178 140.383	
		350.838		904.688
22	146 195.943		179.045 071	
		354.453		929 138
23	146.550 396		179.974.209	
		358.145		954.947
24	146.908.541		180 929.156	
		361 914		982.230
25	147.270.455		181.911.386	
		365.763		1.011.118
26	147.636.218		182.922.504	
		369.695		1 041.757
27	148 005.913		183.964.261	
		373.712		1.074.311
28	148 379.625		185.038.572	
		377.818		1.108.965
29	148.757.443		186 147.537	
		382.015		1.145.930
30	149.139 458		187.293 467	
		386.306		1 185.443
31	149.525.764		188.478.910	
		390.695		1 227.780
32	149 916.459		189.706.690	
		395.185		1.273.252
33	150 311.944		190.979.942	
		399 779		1.322 222
34	150 711.423		192.302.164	
		404.482		1.375.110
35	151.115.905		193.677.274	
		409.296		1.432.406
36	151.525.201		195.109.680	
		414 226		1.494 683
37	151 939.427		196.604.363	
		419.277		1.562.622
38	152 358.704		198.166 985	
		424.452		1.637 032
39	152.783.156		199.804.017	
		429.752		1.718.883
40	153 212.913		201 522.900	
		435 196		1.809.349
41	153.648.109		203.332 249	
		440 774		1 909.868
42	154.088.883		205.242.117	
		446.497		2 022.212
43	154.535.380		207.264 329	
		452.371		2 148.590
44	154 987.751		209.412 928	
		458.402		2.291.838
45	155 446.153		211.704.766	
		464.596		2.455.542
46	155.910.749		214.160 306	
		470 959		2.644 426
47	156 381.708		216.804.732	
		477 499		2.864.794
48	156.859.207		219.669.526	
		484.224		3.125 229
49	157 343.431		222.794.755	
		491.140		3 437.751
50	157.834.571		226.232.506	
		498 257		3.819.723
51	158.332.828		230.052.229	
		505.582		4.297.187
52	158.838 411		234 349.416	
		513.129		4.911.090
53	159 351.540		239.260.506	
		520 902		5.729.580
54	159 872 442		244.990.086	
		528.915		6.875 496
55	160 401.357		251.865.582	
		537.178		8.594.338
56	160 938.535		260.459.920	
		545.704		11.450.157
57	161 484.239		271 919.077	
		554.505		17.188.734
58	162 038 744		289 107.811	
		563.594		34.377.468
59	162.602.338		323.485 279	
		572.986		

CHAP. III.

The use of the two first columnes of the Table of Latitudes, for graduating a Meridian in the general Sea-Chart.

BEfore you can make use of this Table, for the true graduating, or dividing of a Meridian of this Chart into his degrees, or other parts of Latitude, increasing from the *Æquinoctial* towards the North and South, in such proportion, as before hath been shewed, there must be first some preparation made to that end; which may be done after this manner: Overthwart the midst of the plain superficies, whereupon you will draw the lineaments of the Chart, describe a right line, (representing the Æquinoctial circle) which you shall divide into 360 parts or degrees, and crosse the same squirewise with right lines, by every fift or tenth degree. Then take with your compasses the length of half the Æquinoctial, (that is, 180 degrees) and setting one foote of your compasses in the mutuall intersection of the Æquinoctial, with the perpendicular or Meridian that passeth by either end of the Æquinoctial, with the other foote make a prick in the same perpendicular or Meridian: the space contained betwixt this prick and the Æquinoctial, divide first into three equal parts, and every one of these into other three, so have you nine in all: and againe every one of these into three, so have you 27 parts, and every one of these parts divide into four, so have you 108 parts: And againe (if there be space enough) divide every one of these into 10 or 100. So shall you have 1080, or 10800 parts, which will bring you to the Latitude of 85 degrees and something more. But if you would make your Chart to any greater Latitude, you shall continue forth the foresaid perpendicular, and divide it into so many more of the same parts as you shall find needful to attain to the Latitude you desire. Then note every fift and tenth part with black lead, and set figures at them, beginning at the Æquinoctial and from thence proceeding Northwards and Southwards. Then look what numbers in the second column are answerable to each degree, or minute in the first column of this Table of Latitudes (omitting alwaies four or five of the first figures towards the right hand) and at the same numbers of parts in the perpendiculars, make pricks on either side the Æquinoctial: by which (pricks) draw right lines equidistant from the Æquinoctial, for they shall be

The use of the two first Columns of the Table of Latitudes.

the Parallels of the true Nautical Planiſphere, or Sea-Chart.

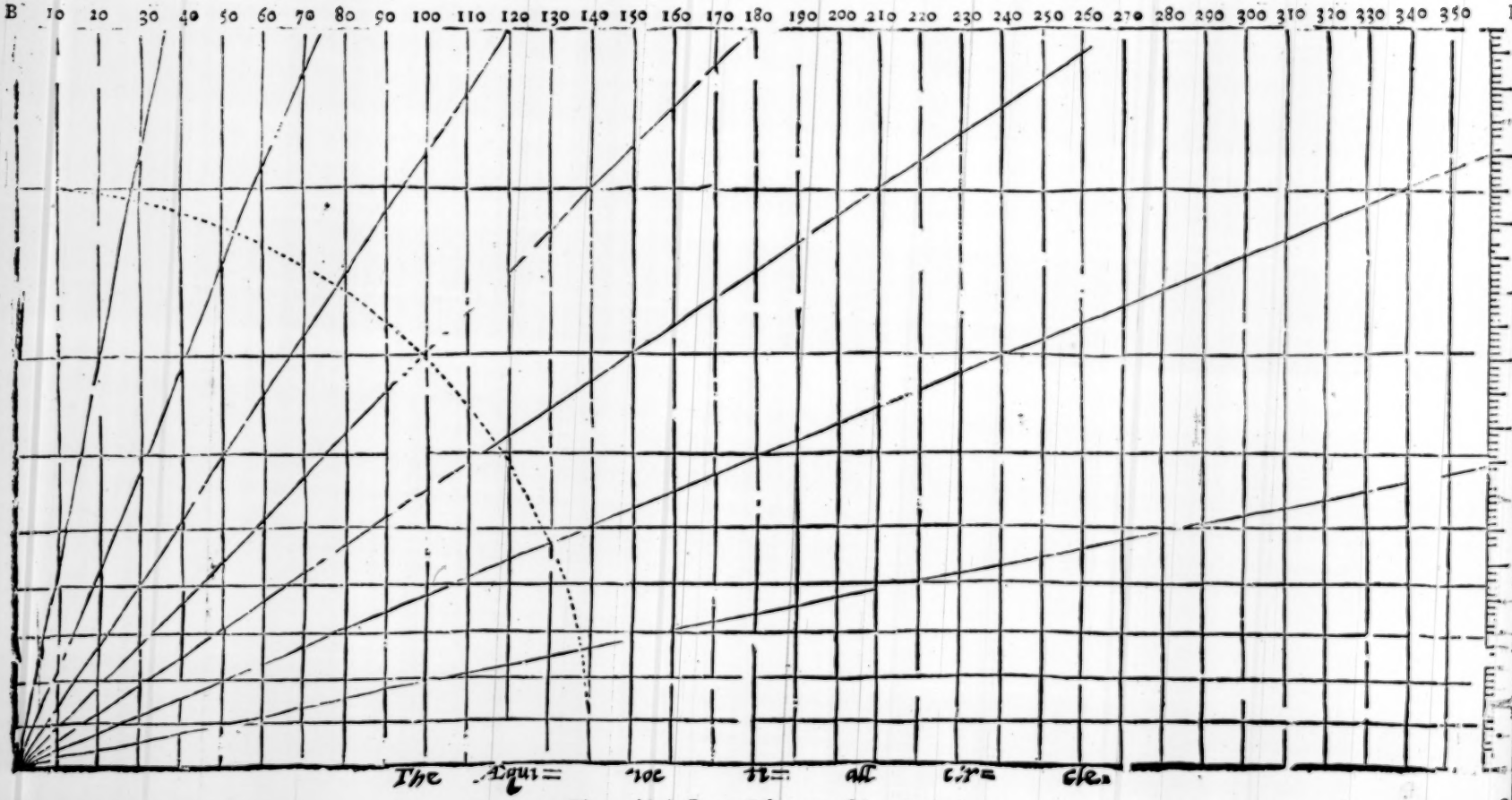
Notwithſtanding theſe Parallels are all of them a little further diſtant from the Æquinoctial then in truth they ſhould be: and ſo much the more, the further they are from the Æquinoctial, Which error might be ſomething the leſſe, if the former Table had been firſt made to ſmaller parts then minutes. But that were a matter more curious then neceſſarie, the Table here before ſet down being ſo neere the truth, that it is not poſſible by any rules or Inſtruments of Navigation, to diſcover any ſenſible error in the Sea-Chart, ſo farre forth as it ſhall be made according thereto.

The figure following containeth onely one part of the Nauticall Planiſphære, from the Æquinoctial Northwards, becauſe the other part from the Æquinoctial Southwards muſt be altogether like and equal to this. Herein firſt I drew the Æquinoctial line A C, and divided it into 36 equal parts, whereof every one is underſtood to contain ten degrees, and I raiſed perpendiculars from every one of thoſe parts; which are the Meridians of the Nauticall Planiſphære, every where æquidiſtant each from other. Then I took half the length of the Æquinoctial with the compaſſes, and ſetting one foot in the end of the Æquinoctial at C, with the other foot I made a prick at D in the perpendicular or Meridian C D. The ſpace contained betwixt C and D, I divided into 1080 parts, (underſtanding every one of the ſmaller parts, or ſegments of the line C D to contain ten leſſer parts) in ſuch ſort as before hath been ſhewed, and ſet figures to them, as here you ſee, for the readier numbring and finding out of any of thoſe parts. Then I looked in the former Table what number of equal parts of the Meridian anſwered to every tenth degree, and (caſting away five of the firſt figures next the right hand (becauſe I conceive the ſpace betwixt C and D to be divided only into 1080 parts) I found out the parts anſwerable to the numbers remaining in the line C D: and at thoſe parts I made prickes, by which I drew the Parallels.

As for example: in the Table, the number anſwerable to ten degrees, is 60, caſting away the five firſt figures towards the right hand: therefore I look 60 in the line C D, and by that part I draw the Parallel of ten degrees diſtance from the Æquinoctial. Likewiſe the number anſwering to twentie degrees (omitting the five firſt figures) is 122: therefore by that number of equal parts I draw the parallel of twentie degrees Latitude from the Equinoctial, &c. And after this manner I drew all the reſt, as you may ſee in the former draught.

CHAP.

The Draught of the Meridians, Parallels and Rumbs, of the Nautical Planisphear, truly made.



Place this in Letter I, between fol. 38. 39.

CHAP. IIII.

ther way for graduating the Meridian of a general Sea-Chart.

OTherwiſe for the dividing of the Meridian of a general Sea-Chart into his degrees, and other ſmaller parts of Latitude, when the Chart hath not ſo great Latitude or breadth from the Equinoctial towards the North or South, as hath the figure before ſet down; you may go thus to work: Firſt find out what proportion the whole Longitude (or lenght of the Chart from Weſt to Eaſt) muſt have to the whole breadth thereof betwixt the Parallels of the moſt Northerly and Southerly places, that are to be ſet down therin: which may be done after this manner: Out of the ſecond Co'umn of the table of Latitudes, take the numbers of equal parts of the Meridian anſwerable to the greateſt North and South Latitudes that are to be ſet down in the Chart: divide thoſe numbers by 600,000 (that is the number of equal parts of the Meridian anſwerable to one degree of the Equinoctial) the Quotients will ſhew how many degrees of the Equinoctial the breadth of the Chart muſt be on either ſide the Equinoctial toward the North and South. As for example, in the generall Sea-Chart to be adjoyned to this book, the Latitude of the North ... of the New land, found by the *Hollanders* about the yeer 596, and by them called *Gebrooken land* (lying Northwards rom *Norway*) is about 80 degrees. And the Latitude of Queen *Elizabeths* Iland (firſt found by Sir *Francis Drake*, lying to the outhwards of *Magellanes ſtreights*) is about 53 degrees. The umbers of equal parts of the Meridian anſwerable to theſe Latudes, found out in the foreſaid *Table of Latitudes*, are 83, 73, 416, and 37, 639, 370; which being divided by 600, 00, the Quotients are 140 and 63 almoſt, ſhewing the breadth the Chart from the Equinoctial Northwards and Southards, in ſuch parts whereof the Equinoctial containeth 360; hich added together ſhall ſhew that the whole breadth of he Chart from North to South muſt be about 203 ſuch parts. aving therefore divided the length of the Equinoctial or any ther parallel of the Chart (becauſe they are all equal) into 60 parts, take with a pair of compaſſes 210 of the ſame parts becauſe that is the next greater number apt for diviſion) and ſo

keeping

keeping them unaltered, set both feet in the Meridian at one of the ends, or in the midst of the Chart, and divide the space conteined betweene them first into seven parts, and every one of them into three, so have you 21 in all: then divide each of these into two, and these againe into five; so shall you have in all 210, the number of the parts required. Now beginning at the Southermost of these parts, tell on Northwards, till you come to 66, and thereby draw the Equinoctial, overthwart the Meridian, at right Angles. After this you may divide the said parts of the Meridian every one into six, drawing forth every fifth or tenth, a little further then the rest, and setting figures to every hundreth part, for the readier finding out of any number of those parts that shall be required. This being done, the Meridian may be divided into his degrees of Latitude, and the parallels drawne after the same manner that we have alreadie shewed for the drawing of the former figure of a generall Sea-Chart, in the Chapter next going before.

CHAP. V.

The use of the table of Latitudes for the true graduating of a particular Sea-Chart.

TO make a particular Sea-Chart: first, consider at what Latitudes your Chart must begin and end: Then looke in the former table of Latitudes what numbers of equal parts are answerable to both those Latitudes, and subtract the equal parts answering to the lesser Latitude, out of the equal parts answerable to the greater Latitude; and drawing a line overthwart the breadth of the Chart from North to South (at one of the ends, or in some other vacant place thereof) divide the same line into so many equal parts, as the difference remaining shall amount unto: if that difference bee a compound number that may be divided into his unities by small divisors. But if it fall out that the number of equal parts remaining be either a prime number, or else such a number as cannot otherwise be divided into his unities, but by some great divisors you may then take the next compound number that is greater than the said difference which may bee divided into his unities by small divisors. Thus having divided the line drawne overthwart the breadth of the Chart, into so many equal parts, as the compound number containeth unities, and beginning at

end thereof which is ſuppoſed to bee Southwards, or next the Equinoctial, ſet thereto the next number of whole hundreds, or thoulands, leſſe then the number of equal parts anſwerable to the leſſer Latitude, and drawing forth every fifth, or tenth part, a little further then the reſt, ſet figures to every tenth, huudred, or thouſandth part, that you may readily number and find out any of them.

Then looke in the table of Latitudes which of theſe equal parts anſwer to each degree or half degree, or each tenth minute of Latitude (if your Chart be of a very large prick) and with the point of your penne or compaſſes make marks there, and ſo finiſh the graduation of the Meridian of your Chart after the accuſtomed manner before ſhewed in the former Chapter.

As for example: In the Particular Chart for the Azores hereunto adjoyned, the leaſt Latitude is 36 degrees 10 minutes; the greateſt 52 degrees 20 minutes; the equal parts anſwerable to theſe in the table of Latitudes, (caſting away the four firſt figures towards the right hand) are 2330 for the firſt, and 3698 for the ſecond Latitude. The difference of theſe is 1368. Then at the Weſt end of the Chart I draw the line A B ſomething longer then the breadth of the Chart which I purpoſe to make, and divide it into 1400 parts, ſuppoſing every one of thoſe ſmalleſt parts to ſtand for two. And this I doe by dividing the whole line firſt into two parts, and each of theſe againe into ſeven; ſo have you 14 parts in all, whereof every one muſt bee underſtood to be divided into 100 equal parts after the ordinarie manner, firſt dividing each of them into two parts, then every one of thoſe into five, and theſe againe every one into five parts, &c.

Now becauſe the leaſt Latitude in this Chart beginneth at 2330 equal parts, I do therefore account the beginning of the line A B at A to be at 2300, and ſo proceed ſetting down numbers at every 100 part, as in that Chart you may ſee.

Now for graduating the Meridian that is adjoyning, or rather all one with the line A B, you may proceed in like ſort, as before was ſhewed, for the making of a generall Sea-Chart in the thid chapter: looking what number of equal parts anſwer to each degree in the table of Latitudes; and at the ſame number of equal parts in the Chart, making marks ſignifying thoſe degrees, &c. As for example: In the table I finde anſwerable to 37 dgrees 0 minutes 2393, (caſting away the foure firſt figures

next the right hand) therefore at the same number of equal parts in the line A B in the Chart, I draw forth the line of 37 degrees Latitude. In like manner, at 2468 equal parts in the Chart I set downe 38 degrees, because in the table of Latitudes I finde that number answerable to 38 degrees: And at 2545 I set 39 degrees. And so forth for all the rest.

In like sort you may out of the table of Latitudes set downe every tenth or fifth minute into this Chart; or else (which is also something easier, and not altogether so tedious) you may with a paire of compasses divide each degree in the Chart into 12 equal parts. In which division, although indeede there will be some error; yet in this particular Chart, or others not much exceeding this in the greatnesse either of the Latitude, or of the degrees thereof, that error will bee so small, as that by sense it can either not at all, or very hardly be discerned.

CHAP. VI.

The breadth of a particular Chart being given, to divide the same into the degrees and minutes contained in the difference of the least and greatest Latitudes therein to be expressed.

BVt if you would make your Chart to a certaine breadth limitted, which you also desire to divide unequally in due proportion (as hath been shewed) into the number of degrees and min, conteined between the least and greatest latitudes which you would have therein set downe: you may then goe thus to worke: Draw a line equal to the breadth of the Chart (as for example, the line C D at the East end of the particular Chart for the Azores) from the South end hereof draw another line something longer, making an angle therewith of some 20 or 30 degrees, or thereabouts, as the line C E: And having found out (as before in the former chapter) the number of equal parts answerable to the difference of the least and greatest Latitudes, (as the number of 1368) divide this line C E into some compound number of parts that may be divided by small divisors; (that compound number exceeding the number of those equal parts so little as conveniently may be) as into 1400. In this line, beginning from the angle at C, tell out the said number of equal parts 1368, from thence draw the base of that angle to the end of the first line (as the line F D:) for

D:) for Parallels to this baſe, drawne by the diviſions of the ſecond line C E, ſhall divide the firſt line C D (that meaſureth the breadth of the Chart) into the number of equal parts anſwerable to the difference of the leaſt and greateſt Latitude in the Chart. But becauſe the drawing of ſo many Parallels would not onely be troubleſome and tedious, but may alſo ſomething deface the Chart; it will be better to draw Parallels by ſome few principall compound numbers of parts in the ſecond line, as by every 100 or 1000 &c. to ſub-divide with the compaſſes the ſegments of the firſt line contained between thoſe Parallels, as in this particular Chart you may ſee. Thus having divided the breadth of the Chart into the number of parts required, and beginning at C the South end thereof to tell 2330, (which is the number of equal parts anſwerable to the leaſt Latitude purpoſed to be ſet downe in the Chart) tell on Northwards till you come to make up an even hundred (as till you come to 2400) and there begin to ſet figures, ſhewing the number of the parts; and ſo proceed, ſetting figures to every hundred part, and finiſhing the graduation of the Meridian or diviſion thereof into his unequal parts in due proportion, as before you were directed in the former chapter.

CHAP. VII.

The uſe of the third columne of the table of Latitudes.

THe third Columne being nothing elſe but the table of Secants, in ſuch parts whereof the whole ſine or ſemidiameter of the circle is ſuppoſed to containe 10,000, may ſerve for all ſuch purpoſes for which the table of Secans may be uſed. Moreover, as it ſerved for the making of the ſecond columne of the table of Latitudes, as before is ſhewed in the ſecond chapter, page 11 and 12, ſo may it be of needfull uſe for the more eaſie examination and correction thereof, if any error hath been committed therein.

Hereby alſo may bee knowne very exactly the proportion of any parallel to the Equinoctiall. For what proportion the difference anſwerable to any degree and minute in this table hath to 10 000, the ſame proportion hath the Equinoctiall to the parallel anſwering to that degree and minute: (The difference anſwerable to any degree and minute is that which is placed

next above the line of the same minute:) And consequently, because the like parts of circles are proportional to their wholes, you may hereby very easily and truly finde out how many leagues any arch of any Parallel containeth: for as the difference answerable to the Latitude of the Parallel is to 10,000, so are the minutes contained in that arch to the miles thereof; which divided by 3, give the leagues.

As for example, if you would know how many leagues make a degree in the Parallel of *London*, whose Latitude is 51 degrees 32 minutes: as 16,075 the difference answering to that Latitude page 26 is to 10,000, so is 20 (the number of leagues contained in one degree of the Equinoctiall) to $12\frac{284}{843}$ the number of leagues making one degree in the Parallel of *London*. Thus the difference of Longitude in any Parallel being given in degrees, may easily be reduced into leagues, multiplying the same by the leagues contained in one degree. But it may be done easier by multiplying the difference of Longitude (reduced into minutes) by 10,000, and dividing the product by the difference of equal parts (in the table of Latitudes) answerable to the Latitude of the Parallel wherein that difference of Longitude is taken; for then the quotient sheweth the miles in the difference of Longitude, which being divided by 3, you have the leagues.

As for example: admit the difference of Longitude betweene the *Lizard* and *Fayal* be 22 degrees 52 minutes, that is 1372 minutes, which multiplied by 10,000, make 13,720,000: and this divided by 12,898 (which is the difference of the equal parts answerable to 39 degrees 10 minutes, the latitude of the Northeast corner of *Fayal* Iland) shall give you 1064 miles almost, that is $354\frac{2}{3}$ leagues, the difference of their Longitudes counted in the Parallel of *Fayal*.

Moreover, by the differences set downe in the third columne may easily be found the sine of any arch of the quadrant: For as the difference answerable to any arch, or number of degrees and minutes in this table is to 10,000; so is 10,000 to the sine of the same arch.

The demonstration hereof may easily be conceived out of the Diagramme set down in the second chapter, page. 11, wherein *i k* to *f k*. and *a k* to *g k*, that is *a e*, have all one and the same proportion; and therefore it shall here be needlesse any further to insist hereupon,

CHAP.

Chap. VIII.

How to deſcribe the Rumbes mechanically in any Sea-chart, Globe, or Mappe of what forme ſoever.

NOw becauſe the nauticall planiſphære (as before hath been ſhewed) is nothing elſe but a plaine Parallellogramme ſuperficies, made by extenſion of a ſphærical ſuperficies inſcribed into a concave cylinder, wherein the rumbes make equal angles with every Meridian: therefore in this nauticall planiſphære, if a circle be drawne and divided into 32 equal parts, beginning at the Meridian paſſing by the center, of that circle: right lines drawne from the center by thoſe diviſions ſhall be the rumbes or lines which the ſhip deſcribeth in ſailing upon thoſe points, becauſe they make equal angles with every Meridian of the nautical planiſphære, thoſe Meridians being every where equidiſtant one from another. Example hereof you have in the former figure, and in the charts adjoyned hereunto.

By helpe of this planiſphære with the Meridians, rumbes, and Parallels thus deſcribed therein, the rumbes may much more eaſily and truly be drawne in the Globe, then by thoſe mechanical waies which *Petrus Nonius* teacheth, *cap. 26. lib. 2. de obſer. Reg. & Inſtr. Geom.* Hereby alſo they may with no leſſe facilitie be inſcribed into any other Chart or Mappe of what forme or projection ſoever, it it be firſt divided by Meridians and Parallels into degrees of Longitude and Latitude: For by what points of Longitude and Latitude in this Planiſphære the rumbes are deſcribed, by the ſame points muſt they be drawne in the Globe, or in any other Chart or Mappe whatſoever. Notwithſtanding this may much more exactly be performed by the table of Rumbes following, which I have made for that purpoſe, ſhewing for every degree of Longitude, by what degree, and minute of Latitude every rumbe is to bee drawne till you come within a minute of the Pole.

Chap. IX.

The uſe of the table of Latitudes for making the table of Rumbs.

THis table of Rumbes is moſt eaſily made by addition only with help of the former table of Latitudes after this manner: Multiplie the *Tangent* of the angle that the rumbe maketh with the Equinoctial by 60 (becauſe

cause every degree of the Equinoctial in that table is understood to containe 60 times 10000 parts, each minute containing (by supposition) 10000 parts:) the product shall be the first number at the beginning of the table of each rumbe, to be set over against one degree of Longitude, and all the rest are found by perpetuall addition of this number, first to it self (for the summe is the number answerable to two degrees of Longitude) then to this summe; (the product is the number that answereth to three degrees of Longitude) and so forth in all the rest. These numbers being found out in the table of Latitudes, did shew at what point of Latitude each rumbe should crosse the Meridian for every degree of Longitude, till you come within a minute of the Pole. But these numbers were not thought needfull to be set down in the table following, because they serve onely for finding out the Latitudes, by which the rumbes must be drawn at every degree of Longitude; which Latitudes being once found, these numbers serve to no further use.

Take for example the first rumbe from the Equinoctial, making an angle therewith of 11 degrees 15 minutes the tangent whereof 1,989,122 (the whole sine being 10000000) multiplied by 60, maketh 119,347,320: but cutting off the three first figures, and seeking out the rest in the table of Latitudes, you shall finde answerable thereto 12 minutes the Latitude of that rumbe at one degree of Longitude. Also the same number doubled (that is 238,694) and found out in the same table, shall give you 24 minutes almost, the Latitude of the same rumbe for two degrees of Longitude: and so forth in the rest.

Hereby it may appeare that the Latitude of any rumbe, whatsoever angle it make with the Equinoctial, may presently be found for any Longitude you shall desire, if you doe but multiplie the number answering to one degree of Longitude (found as before) by the Longitude given, and finde out the product in the second columne of the foresaid table of Latitudes: for the number of degrees, minutes, &c. answering thereto in the first columne of that table shall be the *Latitude* desired.

As for example, suppose a rumbe that maketh an angle of 5 degrees with the Equinoctial, I would know what *Latitude* this rumbe must have at 360 degrees of *Longitude*: the tangent of five degrees is 874,887, which multiplied by 60, make 52,493.220, and this againe by 360 maketh 18.897.559.200; but cutting off the three first figures, the rest found in the foresaid table shall give us 70 degrees, 1 minute, the *Latitude* of that Rumb at 360 degrees of *Longitude*. The

The first Rumb from the Meridian, *viz. North and by East, North and by West. South and by East, South and by West.*

The first Rumb from the Meridians, viz. North and by East, North and by West. South and by East, South and by West.

lõg	Latit	lõg	Latitude
gr.	gr. m	gr.	gr. mi. sec
1	5 1	61	89 27 2
2	10 0	62	89 29 46
3	14 55	63	89 32 15
4	19 43	64	89 34 33
5	24 22	65	89 36 39
6	28 52	66	89 38 33
7	33 10	67	89 40 19
8	37 16	68	89 41 56
9	41 10	69	89 43 24
10	44 50	70	89 44 45
11	48 15	71	89 46 0
12	51 32	72	89 47 8
13	54 33	73	89 48 10
14	57 22	74	89 49 7
15	59 58	75	89 49 57
16	62 24	76	89 50 47
17	64 38	77	89 51 31
18	66 42	78	89 52 11
19	68 37	79	89 52 38
20	70 22	80	89 53 5
21	72 0	81	89 53 43
22	73 29	82	89 54 20
23	74 51	83	89 54 46
24	76 7	84	89 55 11
25	77 16	85	89 55 30
26	78 20	86	89 55 53
27	79 18	87	89 56 11
28	80 12	88	89 56 28
29	81 1	89	89 56 44
30	81 46	90	89 56 58
31	82 27	91	89 57 10
32	83 5	92	89 57 22
33	83 40	93	89 57 33
34	84 12	94	89 57 43
35	84 40	95	89 57 53
36	85 8	96	89 58 2
37	85 32	97	89 58 9
38	85 55	98	89 58 15
39	86 15	99	89 58 21
40	86 34	100	89 58 27
41	86 51	101	89 58 33
42	87 8	102	89 58 38
43	87 22	103	89 58 43
44	87 35	104	89 58 47
45	87 47	105	89 58 51
46	87 58	106	89 58 55
47	88 9	107	89 58 59
48	88 18	108	89 59 3
49	88 26	109	89 59 6
50	88 34	110	89 59 9
51	88 41	111	89 59 12
52	88 48	112	89 59 15
53	88 54	113	89 59 18
54	88 59	114	89 59 20
55	89 5	115	89 59 22
56	89 9	116	89 59 24
57	89 13	117	89 59 26
58	89 17	118	89 59 28
59	89 21	119	89 59 30
60	89 24	120	89 59 32

The second Rumb from the Meridian, viz. North North-east. North North-west: South South-east, South South-west.

lõg	Latit	lõg	Latit
gr.	gr. m	gr.	gr. mi
1	2 25	61	81 15
2	4 49	62	81 36
3	7 14	63	81 57
4	9 37	64	82 17
5	11 59	65	82 36
6	14 20	66	82 54
7	16 40	67	83 12
8	18 58	68	83 28
9	21 14	69	83 44
10	23 27	70	84 0
11	25 39	71	84 15
12	27 49	72	84 29
13	29 55	73	84 42
14	32 0	74	84 56
15	34 1	75	85 8
16	36 0	76	85 20
17	37 55	77	85 32
18	39 48	78	85 43
19	41 38	79	85 53
20	43 25	80	86 3
21	45 8	81	86 13
22	46 49	82	86 22
23	48 27	83	86 31
24	50 1	84	86 40
25	51 33	85	86 48
26	53 1	86	86 57
27	54 27	87	87 4
28	55 50	88	87 11
29	57 10	89	87 18
30	58 27	90	87 25
31	59 41	91	87 37
32	60 53	92	87 49
33	62 2	93	87 59
34	63 9	94	88 9
35	64 13	100	88 13
36	65 15	102	88 26
37	66 14	104	88 34
38	67 12	106	88 41
39	68 7	108	88 47
40	69 0	110	88 53
41	69 50	112	88 58
42	70 39	114	89 3
43	71 26	116	89 8
44	72 12	118	89 12
45	72 55	120	89 16
46	73 37	122	89 19
47	74 17	124	89 23
48	74 55	126	89 26
49	75 32	128	89 28
50	76 8	130	89 31
51	76 42	134	89 35
52	77 14	138	89 39
53	77 46	142	89 42
54	78 16	146	89 45
55	78 44	150	89 47
56	79 12	158	89 51
57	79 39	166	89 53
58	80 4	178	89 56
59	80 29	201	89 58
60	80 52	225	89 59

The third Rumb from the Meridians, viz. North-east by North, Northwest by North: South-east by South, South-west by South.

lõg	Latit	lõg	Latit	lõg	Latit	lõg	Latit	lõg	Latit
gr.	gr. m	gr.	gr. m	gr.	gr. m	gr.	gr. m	gr	gr. m
1	1 30	61	67 1	121	85 8	181	88 59		
2	3 0	62	67 36	122	85 16	182	89 0		
3	4 29	63	68 10	123	85 23	183	89 2		
4	5 59	64	68 43	124	85 30	184	89 3		
5	7 28	65	69 15	125	85 37	185	89 5		
6	8 57	66	69 46	126	85 43	186	89 6		
7	10 25	67	70 17	127	85 50	187	89 8		
8	11 53	68	70 47	128	85 57	188	89 9		
9	13 21	69	71 16	129	86 3	189	89 10		
10	14 48	70	71 44	130	86 9	190	89 12		
11	16 14	71	72 12	131	86 15	191	89 13		
12	17 40	72	72 39	132	86 21	192	89 14		
13	19 6	73	73 6	133	86 27	193	89 15		
14	20 30	74	73 32	134	86 32	194	89 16		
15	21 54	75	73 57	135	86 37	195	89 17		
16	23 17	76	74 21	136	86 43	196	89 19		
17	24 39	77	74 45	137	86 48	197	89 20		
18	26 0	78	75 8	138	86 52	198	89 21		
19	27 20	79	75 31	139	86 58	199	89 22		
20	28 39	80	75 53	140	87 3	200	89 23		
21	29 58	81	76 15	141	87 7	201	89 24		
22	31 15	82	76 36	142	87 12	202	89 24		
23	32 31	83	76 56	143	87 16	203	89 25		
24	33 46	84	77 16	144	87 20	204	89 26		
25	35 0	85	77 36	145	87 24	205	89 27		
26	36 13	86	77 55	146	87 28	206	89 28		
27	37 25	87	78 14	147	87 32	207	89 29		
28	38 36	88	78 32	148	87 36	208	89 30		
29	39 46	89	78 49	149	87 40	209	89 30		
30	40 54	90	79 6	150	87 43	210	89 31		
31	42 1	91	79 23	151	87 47	212	89 33		
32	43 8	92	79 40	152	87 50	214	89 34		
33	44 12	93	79 55	153	87 54	216	89 35		
34	45 16	94	80 11	154	87 57	218	89 36		
35	46 19	95	80 26	155	88 0	220	89 38		
36	47 20	96	80 41	156	88 3	222	89 39		
37	48 21	97	80 55	157	88 6	224	89 40		
38	49 20	98	81 9	158	88 9	226	89 41		
39	50 18	99	81 23	159	88 12	228	89 42		
40	51 14	100	81 36	160	88 15	230	89 43		
41	52 10	101	81 49	161	88 17	234	89 44		
42	53 5	102	82 2	162	88 20	238	89 46		
43	53 58	103	82 14	163	88 22	242	89 47		
44	54 50	104	82 26	164	88 25	246	89 48		
45	55 41	105	82 37	165	88 27	250	89 49		
46	56 31	106	82 49	166	88 30	254	89 50		
47	57 20	107	83 0	167	88 32	258	89 51		
48	58 8	108	83 11	168	88 34	262	89 52		
49	58 55	109	83 21	169	88 37	266	89 53		
50	59 41	110	83 31	170	88 39	270	89 54		
51	60 26	111	83 41	171	88 41	276	89 54		
52	61 10	112	83 51	172	88 43	282	89 55		
53	61 52	113	84 1	173	88 45	288	89 56		
54	62 34	114	84 10	174	88 47	294	89 56		
55	63 15	115	84 19	175	88 49	300	89 57		
56	63 55	116	84 28	176	88 50	312	89 58		
57	64 34	117	84 36	177	88 52	324	89 59		
58	65 12	118	84 44	178	88 54	336	89 59		
59	65 49	119	84 53	179	88 55	348	89 59		
60	66 26	120	85 1	180	88 57	360	89 59		

The fourth Rumb from the Meridian, viz. North-east, North-west. South-east, South-west.

log	Latit	log	Latit	log	Latit	log	Latit	log	Latit	log	Latit	log	Latit	log	Latit
gr.	gr m	gr.	gr. m	gr.	gr. m	gr.	gr. m	gr.	gr. m	gr.	gr. m	gr.	gr. m	gr.	gr. m
1	1 0	61	51 57	121	76 12	181	85 8	241	88 17	302	89 24				
2	2 0	62	52 33	122	76 26	182	85 13	242	88 19	304	89 25				
3	3 0	63	53 10	123	76 40	183	85 18	243	88 21	306	89 27				
4	4 0	64	53 45	124	76 54	184	85 23	244	88 23	308	89 28				
5	5 0	65	54 21	125	77 7	185	85 27	245	88 24	310	89 29				
6	5 59	66	54 55	126	77 20	186	85 32	246	88 26	312	89 30				
7	6 59	67	55 30	127	77 33	187	85 37	247	88 28	314	89 31				
8	7 58	68	56 3	128	77 46	188	85 41	248	88 29	316	89 32				
9	8 58	69	56 37	129	77 59	189	85 46	249	88 31	318	89 33				
10	9 57	70	57 9	130	78 11	190	85 50	250	88 32	320	89 34				
11	10 56	71	57 42	131	78 23	191	85 54	251	88 34	322	89 35				
12	11 55	72	58 13	132	78 35	192	85 59	252	88 35	324	89 36				
13	12 53	73	58 45	133	78 47	193	86 3	253	88 37	326	89 36				
14	13 52	74	59 16	134	78 59	194	86 7	254	88 38	328	89 37				
15	14 50	75	59 46	135	79 10	195	86 11	255	88 39	330	89 38				
16	15 48	76	60 16	136	79 21	196	86 15	256	88 41	332	89 39				
17	16 45	77	60 46	137	79 32	197	86 19	257	88 42	334	89 39				
18	17 43	78	61 15	138	79 43	198	86 23	258	88 44	336	89 40				
19	18 40	79	61 43	139	79 53	199	86 27	259	88 45	338	89 41				
20	19 36	80	62 12	140	80 4	200	86 31	260	88 46	340	89 42				
21	20 33	81	62 39	141	80 14	201	86 34	261	88 47	342	89 42				
22	21 29	82	63 7	142	80 24	202	86 37	262	88 49	344	89 43				
23	22 24	83	63 34	143	80 34	203	86 41	263	88 50	346	89 43				
24	23 20	84	64 0	144	80 44	204	86 44	264	88 51	348	89 44				
25	24 15	85	64 26	145	80 53	205	86 48	265	88 52	350	89 44				
26	25 9	86	64 52	146	81 3	206	86 51	266	88 53	352	89 45				
27	26 3	87	65 17	147	81 12	207	86 55	267	88 55	354	89 45				
28	26 57	88	65 42	148	81 21	208	86 58	268	88 56	356	89 46				
29	27 51	89	66 6	149	81 30	209	87 1	269	88 57	358	89 46				
30	28 43	90	66 31	150	81 39	210	87 4	270	88 58	360	89 47				
31	29 35	91	66 54	151	81 48	211	87 7	271	88 59	6	89 48				
32	30 28	92	67 18	152	81 56	212	87 10	272	89 0	12	89 49				
33	31 19	93	67 41	153	82 4	213	87 13	273	89 1	18	89 50				
34	32 10	94	68 3	154	82 13	214	87 16	274	89 2	24	89 51				
35	33 0	95	68 25	155	82 21	215	87 19	275	89 3	30	89 52				
36	33 50	96	68 47	156	82 20	216	87 22	276	89 4	36	89 53				
37	34 40	97	69 9	157	82 36	217	87 24	277	89 5	42	89 53				
38	35 29	98	69 30	158	82 44	218	87 27	278	89 6	48	89 54				
39	36 18	99	69 51	159	82 51	219	87 30	279	89 7	54	89 55				
40	37 6	100	70 11	160	82 59	220	87 32	280	89 8	60	89 55				
41	37 53	101	70 31	161	83 6	221	87 35	281	89 9	66	89 55				
42	38 41	102	70 51	162	83 13	222	87 37	282	89 10	72	89 56				
43	39 27	103	71 11	163	83 20	223	87 40	283	89 10	78	89 56				
44	40 13	104	71 30	164	83 27	224	87 42	284	89 11	84	89 57				
45	40 59	105	71 49	165	83 34	225	87 44	285	89 12	90	89 57				
46	41 44	106	72 7	166	83 41	226	87 47	286	89 13	96	89 57				
47	42 28	107	72 26	167	83 47	227	87 49	287	89 14	102	89 57				
48	43 12	108	72 44	168	83 54	228	87 51	288	89 15	108	89 58				
49	43 56	109	73 1	169	84 0	229	87 54	289	89 15	114	89 58				
50	44 39	110	73 19	170	84 6	230	87 56	290	89 16	120	89 58				
51	45 21	111	73 36	171	84 12	231	87 58	291	89 17	126	89 58				
52	46 3	112	73 53	172	84 18	232	88 0	292	89 18	132	89 58				
53	46 44	113	74 9	173	84 24	233	88 2	293	89 18	138	89 58				
54	47 25	114	74 25	174	84 30	234	88 4	294	89 19	144	89 58				
55	48 6	115	74 41	175	84 36	235	88 6	295	89 20	150	89 59				
56	48 45	116	74 57	176	84 41	236	88 8	296	89 21	156	89 59				
57	49 25	117	75 12	177	84 47	237	88 10	297	89 21	162	89 59				
58	50 3	118	75 28	178	84 52	238	88 12	298	89 22	168	89 59				
59	50 42	119	75 43	179	84 57	239	88 14	299	89 23	174	89 59				
60	51 19	120	75 57	180	85 2	240	88 16	300	89 23	180	90 0				

The fifth Rumb from the Meridian, viz. North-east & by East, South-east & by East. North-west & by West, South-west & by West.

log	Latit	log	Latit	log	Latit	log	Latit	log	Latit	log	Latit	log	Latit	log	Latit
gr.	gr. m	gr.	gr. m	gr.	gr. m	gr.	gr. m	gr.	gr. m	gr.	gr. m	gr.	gr. m	gr.	gr. m
1	0 40	61	37 42												
2	1 20	62	38 14												
3	2 0	63	38 45												
4	2 40	64	39 16												
5	3 20	65	36 47												
6	4 0	66	40 18												
7	4 40	67	40 48												
8	5 20	68	41 18												
9	6 0	69	41 48												
10	6 40	70	42 18												
11	7 20	71	42 48												
12	8 0	72	43 17												
13	8 39	73	43 46												
14	9 19	74	44 14												
15	9 58	75	44 44												
16	10 38	76	45 12												
17	11 17	77	45 40												
18	11 56	78	46 8												
19	12 36	79	46 36												
20	13 15	80	47 3												
21	13 54	81	47 30												
22	14 32	82	47 57												
23	15 11	83	48 24												
24	15 50	84	48 50												
25	16 28	85	49 17												
26	17 7	86	49 43												
27	17 45	87	50 9												
28	18 23	88	50 34												
29	19 1	89	50 59												
30	19 39	90	51 25												
31	20 17	91	51 49												
32	20 54	92	52 14												
33	21 31	93	52 39												
34	22 9	94	53 3												
35	22 46	95	53 27												
36	23 23	96	53 50												
37	23 59	97	54 14												
38	24 36	98	54 37												
39	25 12	99	55 0												
40	25 48	100	55 23												
41	26 24	101	55 46												
42	27 0	102	56 8												
43	27 36	103	56 31												
44	28 11	104	56 53												
45	28 47	105	57 14												
46	29 22	106	57 36												
47	29 56	107	57 57												
48	30 31	108	58 19												
49	31 5	109	58 40												
50	31 40	110	59 0												
51	32 14	111	59 20												
52	32 48	112	59 41												
53	33 21	113	60 1												
54	33 55	114	60 21												
55	34 28	115	60 41												
56	35 1	116	61 0												
57	35 33	117	61 20												
58	36 5	118	61 39												
59	36 38	119	61 58												
60	37 10	120	62 17												

lōg	Latit	lōg	Latit	lōg	Latit	lōg	Latit	lōg	Latit	lōg	Latit	lōg	Latit	lōg	Latit	lōg	Latit	lōg	Latit
gr.	gr. m	gr.	gr. m	gr	gr. m	gr.	gr. m	gr.	gr. m	m gr.	gr. m	gr.	gr. m	gr.	gr. m	gr.	gr. m	gr.	gr. m
121	62 35	181	76 11	241	83 6	301	86 34	1	88 18	92	89 24		10 25	61	24 29	121	44 43		
122	62 53	182	76 20	242	83 11	302	86 36	2	88 19	94	89 25		20 50	62	24 52	122	45 1		
123	63 12	183	76 30	243	83 16	303	86 39	3	88 20	96	89 26		31 15	63	25 14	123	45 18		
124	63 30	184	76 39	244	83 21	304	86 41	4	88 21	98	89 27		41 39	64	25 37	124	45 36		
125	63 47	185	76 48	245	83 25	305	86 43	5	88 22	100	89 27		52 4	65	25 59	125	45 53		
126	64 6	186	76 57	246	83 30	306	86 46	6	88 23	102	89 28		62 29	66	26 21	126	46 10		
127	64 22	187	77 6	247	83 34	307	86 48	7	88 25	104	89 29		72 54	67	26 44	127	46 28		
128	64 40	188	77 15	248	83 39	308	86 50	8	88 26	106	89 30		83 19	68	27 6	128	46 45		
129	64 57	189	77 24	249	83 43	309	86 57	9	88 27	108	89 30		93 44	69	27 28	129	47 2		
130	65 14	190	77 33	250	83 47	310	86 55	10	88 28	110	89 31		104 8	70	27 50	130	47 19		
131	65 30	191	77 41	251	83 52	311	86 57	11	88 29	112	89 32		114 33	71	28 12	131	47 35		
132	65 47	192	77 50	252	84 56	312	86 59	12	88 30	114	89 32		124 58	72	28 34	132	47 53		
133	66 3	193	77 58	253	84 0	313	87 1	13	88 31	116	89 33		135 23	73	28 55	133	48 9		
134	66 19	194	78 6	254	84 4	314	87 3	14	88 32	118	89 33		145 47	74	29 17	134	48 25		
135	66 35	195	78 15	255	84 8	315	87 6	15	88 33	120	89 34		150 12	75	29 39	135	48 42		
136	66 51	196	78 23	256	84 13	316	87 8	16	88 34	122	89 35		166 37	76	30 0	136	48 58		
137	67 7	197	78 31	257	84 17	317	87 10	17	88 35	124	89 35		177 1	77	30 22	137	49 14		
138	67 22	198	78 39	258	84 21	318	87 12	18	88 36	126	89 36		187 26	78	30 43	138	49 31		
139	67 38	199	78 47	259	84 24	319	87 13	19	88 37	128	89 36		197 51	79	31 5	139	49 47		
140	67 53	200	78 54	260	84 28	320	87 15	20	88 38	130	89 37		208 15	80	31 20	140	50 3		
141	68 8	201	79 2	261	84 32	321	87 17	21	88 39	132	89 37		218 40	81	31 46	141	50 18		
142	68 23	202	79 10	262	84 36	322	87 19	22	88 40	134	89 38		229 4	82	32 8	142	50 34		
143	68 37	203	79 17	263	84 40	323	87 21	23	88 41	136	89 38		239 29	83	32 29	143	50 51		
144	68 52	204	79 24	264	84 43	324	87 23	24	88 42	138	89 39		249 54	84	32 50	144	51 6		
145	69 6	205	79 32	265	84 47	325	87 25	25	88 43	140	89 39		251 17	85	33 10	145	51 21		
146	69 21	206	79 39	266	84 51	326	87 26	26	88 43	142	89 40		261 0	86	33 32	146	51 37		
147	69 35	207	79 46	267	84 54	327	87 28	27	88 44	144	89 40		271 11	87	33 52	147	51 53		
148	69 49	208	79 53	268	84 58	328	87 30	28	88 45	146	89 41		281 11	88	34 12	148	52 7		
149	70 2	209	80 0	269	85 1	329	87 32	29	88 46	148	89 41		291 11	89	34 33	149	52 23		
150	70 16	210	80 7	270	85 5	330	87 33	30	88 47	150	89 42		301 12	90	34 54	150	52 38		
151	70 29	211	80 14	271	85 8	331	87 35	32	88 49	155	89 43		311 12	91	35 14	151	52 53		
152	70 43	212	80 21	272	85 12	332	87 37	34	88 50	160	89 44		321 13	92	35 34	152	53 8		
153	70 56	213	80 27	273	85 15	333	87 38	36	88 52	165	89 44		331 13	93	35 55	153	53 23		
154	71 9	214	80 34	274	85 18	334	87 40	38	88 53	170	89 45		341 13	94	36 15	154	53 37		
155	71 22	215	80 41	275	85 21	335	87 42	40	88 55	175	89 46		351 14	95	36 35	155	53 53		
156	71 35	216	80 47	276	85 25	336	87 43	42	88 56	180	89 47		361 14	96	36 55	156	54 7		
157	71 47	217	80 53	277	85 28	337	87 45	44	88 58	185	89 48		371 15	97	37 14	157	54 21		
158	72 0	218	81 0	278	85 31	338	87 47	46	88 59	190	89 48		381 15	98	37 34	158	54 36		
159	72 12	219	81 6	279	85 34	339	87 48	48	89 1	195	89 49		391 15	99	37 54	159	54 50		
160	72 24	220	81 12	280	85 37	340	87 50	50	89 2	200	89 49		401 16	100	38 13	160	55 4		
161	72 36	221	81 18	281	85 40	341	87 51	52	89 3	210	89 51		411 16	101	38 32	161	55 18		
162	72 48	222	81 24	282	85 43	342	87 53	54	89 5	220	89 52		421 17	102	38 52	162	55 33		
163	73 0	223	81 30	283	85 46	345	87 57	56	89 6	230	89 52		431 17	103	39 12	163	55 47		
164	73 11	224	81 36	284	85 49	344	87 55	58	89 7	240	89 53		441 17	104	39 31	164	56 0		
165	73 23	225	81 42	285	85 52	345	87 57	60	89 8	250	89 54		451 18	105	39 49	165	56 14		
166	73 34	226	81 48	286	85 55	346	87 58	62	89 10	260	89 55		461 18	106	40 8	166	56 28		
167	73 45	227	81 54	287	85 58	347	88 0	64	89 11	270	89 55		471 19	107	40 27	167	56 42		
168	73 57	228	81 59	288	86 0	348	88 1	66	89 12	280	89 56		481 19	108	40 47	168	56 55		
169	74 8	229	82 4	289	86 3	349	88 2	68	89 13	290	89 56		491 19	109	41 6	169	57 9		
170	74 19	230	82 10	290	86 6	350	88 4	70	89 14	300	89 56		501 20	110	41 24	170	57 22		
171	74 29	231	82 15	291	86 8	351	88 5	72	89 15	310	89 57		511 20	111	41 42	171	57 36		
172	74 40	232	82 21	292	86 11	352	88 6	74	89 16	320	89 57		521 21	112	42 1	172	57 50		
173	74 51	233	82 26	293	86 14	353	88 8	76	89 17	330	89 57		531 21	113	42 20	173	58 2		
174	75 1	234	82 31	294	86 17	354	88 9	78	89 18	340	89 58		541 21	114	42 38	174	58 15		
175	75 11	235	82 36	295	86 19	355	88 10	80	89 19	350	89 58		551 22	115	42 56	175	58 28		
176	75 22	236	82 42	296	86 22	356	88 12	82	89 20	360	89 58		561 22	116	43 14	176	58 41		
177	75 32	237	82 47	297	86 25	357	88 13	84	89 21	370	89 58		571 22	117	43 32	177	58 54		
178	75 42	238	82 52	298	86 27	358	88 14	86	89 22	380	89 59		581 23	118	43 50	178	59 7		
179	75 51	239	82 57	299	86 28	359	88 15	88	89 23	390	89 59		591 23	119	44 8	179	59 20		
180	76 1	240	83 2	300	86 32	360	88 17	90	89 23	400	89 59		601 24	120	44 26	180	59 32		

The fifth Rumb from the Meridian *East Northeast, East Southeast, West Northwest, West Southwest.*

Dg	Latit	Dg	Latit	Dg	Latit	Dg	Latit	Dg	Latit	Dg	Latit	Dg	Latit	Dg	Latit	Dg	Latit	Dg	Latit
gr.	gr. m	gr.	gr. m	gr.	gr. m	gr.	gr. m	gr.	gr. m	gr.	gr. m	gr.	gr. m	gr.	gr. m	gr.	gr. m	gr.	gr. m
1	0 0	46	31 43	91	57 19	136	74 55	181	84 32	226	67 54	271	73 57	316	59 9	361	22 48	406	14 37
2	1 0	47	32 26	92	57 52	137	75 16	182	84 34	227	68 4	272	74 4	317	59 34	362	23 21	407	15 0
3	2 0	48	33 9	93	58 25	138	75 37	183	84 37	228	68 13	273	74 10	318	59 58	363	23 54	408	15 23
4	2 59	49	33 52	94	58 58	139	75 58	184	84 39	229	68 22	274	74 17	319	60 22	364	24 27	409	15 46
5	3 59	50	34 35	95	59 31	140	76 19	185	84 41	230	68 31	275	74 24	320	60 45	365	25 0	410	16 9
6	4 59	51	35 18	96	60 4	141	76 40	186	84 44	231	68 40	276	74 31	321	61 9	366	25 33	411	16 32
7	5 59	52	36 1	97	60 37	142	77 1	187	84 46	232	68 49	277	74 37	322	61 32	367	26 6	412	16 55
8	6 59	53	36 44	98	61 10	143	77 22	188	84 48	233	68 58	278	74 44	323	61 56	368	26 39	413	17 18
9	7 59	54	37 27	99	61 43	144	77 43	189	84 50	234	69 7	279	74 50	324	62 19	369	27 12	414	17 41
10	8 59	55	38 10	100	62 16	145	78 4	190	84 53	235	69 16	280	74 57	325	62 43	370	27 45	415	18 4
11	9 59	56	38 53	101	62 49	146	78 25	191	84 55	236	69 25	281	75 3	326	63 6	371	28 18	416	18 27
12	10 59	57	39 36	102	63 22	147	78 46	192	84 57	237	69 34	282	75 9	327	63 29	372	28 51	417	18 50
13	11 59	58	40 19	103	63 55	148	79 7	193	84 59	238	69 43	283	75 16	328	63 53	373	29 24	418	19 13
14	12 59	59	41 2	104	64 28	149	79 28	194	85 1	239	69 52	284	75 22	329	64 16	374	29 57	419	19 36
15	13 59	60	41 45	105	65 1	150	79 49	195	85 4	240	70 1	285	75 28	330	64 39	375	30 30	420	19 59
16	14 59	61	42 28	106	65 34	151	80 10	196	85 6	241	70 8	286	75 35	331	65 3	376	31 3	421	20 22
17	15 59	62	43 11	107	66 7	152	80 31	197	85 8	242	70 16	287	75 41	332	65 26	377	31 36	422	20 45
18	16 59	63	43 54	108	66 40	153	80 52	198	85 10	243	70 25	288	75 47	333	65 49	378	32 9	423	21 8
19	17 59	64	44 37	109	67 13	154	81 13	199	85 12	244	70 33	289	75 54	334	66 13	379	32 42	424	21 31
20	18 59	65	45 20	110	67 46	155	81 34	200	85 14	245	70 41	290	76 0	335	66 36	380	33 15	425	21 54
21	19 59	66	46 3	111	68 19	156	81 55	201	85 16	246	70 49	291	76 6	336	66 59	381	33 48	426	22 17
22	20 59	67	46 46	112	68 52	157	82 16	202	85 18	247	70 57	292	76 13	337	67 23	382	34 21	427	22 40
23	21 59	68	47 29	113	69 25	158	82 37	203	85 20	248	71 6	293	76 19	338	67 46	383	34 54	428	23 3
24	22 59	69	48 12	114	69 58	159	82 58	204	85 22	249	71 14	294	76 25	339	68 9	384	35 27	429	23 26
25	23 59	70	48 55	115	70 31	160	83 19	205	85 24	250	71 22	295	76 31	340	68 33	385	36 0	430	23 49
26	24 59	71	49 38	116	71 4	161	83 40	206	85 26	251	71 29	296	76 38	341	68 56	386	36 33	431	24 12
27	25 59	72	50 21	117	71 37	162	84 1	207	85 28	252	71 37	297	76 44	342	69 19	387	37 6	432	24 35
28	26 59	73	51 4	118	72 10	163	84 22	208	85 30	253	71 45	298	76 50	343	69 43	388	37 39	433	24 58
29	27 59	74	51 47	119	72 43	164	84 43	209	85 32	254	71 53	299	76 57	344	70 6	389	38 12	434	25 21
30	28 59	75	52 30	120	73 16	165	85 4	210	85 34	255	72 1	300	77 3	345	70 29	390	38 45	435	25 44
31	29 59	76	53 13	121	73 49	166	85 25	211	85 36	256	72 8	301	77 3	346	70 53	391	39 18	436	26 7
32	30 59	77	53 56	122	74 22	167	85 46	212	85 38	257	72 16	302	77 8	347	71 16	392	39 51	437	26 30
33	31 59	78	54 39	123	74 55	168	86 7	213	85 40	258	72 23	303	77 14	348	71 39	393	40 24	438	26 53
34	32 59	79	55 22	124	75 28	169	86 28	214	85 42	259	72 31	304	77 19	349	72 3	394	40 57	439	27 16
35	33 59	80	56 5	125	76 1	170	86 49	215	85 44	260	72 38	305	77 25	350	72 26	395	41 30	440	27 39
36	34 59	81	56 48	126	76 34	171	87 10	216	85 46	261	72 46	306	77 30	351	72 49	396	42 3	441	28 2
37	35 59	82	57 31	127	77 7	172	87 31	217	85 48	262	72 53	307	77 35	352	73 13	397	42 36	442	28 25
38	36 59	83	58 14	128	77 40	173	87 52	218	85 50	263	73 0	308	77 41	353	73 36	398	43 9	443	28 48
39	37 59	84	58 57	129	78 13	174	88 13	219	85 52	264	73 7	309	77 46	354	73 59	399	43 42	444	29 11
40	38 59	85	59 40	130	78 46	175	88 34	220	85 54	265	73 15	310	77 51	355	74 23	400	44 15	445	29 34
41	39 59	86	60 23	131	79 19	176	88 55	221	85 56	266	73 22	311	77 56	356	74 46	401	44 48	446	29 57
42	40 59	87	61 6	132	79 52	177	89 16	222	85 58	267	73 29	312	78 2	357	75 9	402	45 21	447	30 20
43	41 59	88	61 49	133	80 25	178	89 37	223	86 0	268	73 36	313	78 7	358	75 33	403	45 54	448	30 43
44	42 59	89	62 32	134	80 58	179	89 58	224	86 2	269	73 45	314	78 12	359	75 56	404	46 27	449	31 6
45	43 59	90	63 15	135	81 31	180	90 19	225	86 4	270	73 57	315	78 17	360	76 19	405	47 0	450	31 29

The seventh Rumb from the Meridian. East and by North, East and by South, West and by North, West and by South.

Dg	Latit	Dg	Latit	Dg	Latit	Dg	Latit	Dg	Latit	Dg	Latit	Dg	Latit	Dg	Latit	Dg	Latit	Dg	Latit
gr.	gr. m	gr.	gr. m	gr.	gr. m	gr.	gr. m	gr.	gr. m	gr.	gr. m	gr.	gr. m	gr.	gr. m	gr.	gr. m	gr.	gr. m
1	0 12	46	9 36	91	18 59	136	28 22	181	37 45	226	47 8	271	56 31	316	65 54	361	75 17	406	84 40
2	0 24	47	9 48	92	19 11	137	28 34	182	37 57	227	47 20	272	56 43	317	66 6	362	75 29	407	84 52
3	0 36	48	10 0	93	19 23	138	28 46	183	38 9	228	47 32	273	56 55	318	66 18	363	75 41	408	85 4
4	0 48	49	10 12	94	19 35	139	28 58	184	38 21	229	47 44	274	57 7	319	66 30	364	75 53	409	85 16
5	1 0	50	10 24	95	19 47	140	29 10	185	38 33	230	47 56	275	57 19	320	66 42	365	76 5	410	85 28
6	1 12	51	10 36	96	19 59	141	29 22	186	38 45	231	48 8	276	57 31	321	66 54	366	76 17	411	85 40
7	1 24	52	10 48	97	20 11	142	29 34	187	38 57	232	48 20	277	57 43	322	67 6	367	76 29	412	85 52
8	1 36	53	11 0	98	20 23	143	29 46	188	39 9	233	48 32	278	57 55	323	67 18	368	76 41	413	86 4
9	1 48	54	11 12	99	20 35	144	29 58	189	39 21	234	48 44	279	58 7	324	67 30	369	76 53	414	86 16
10	2 0	55	11 24	100	20 47	145	30 10	190	39 33	235	48 56	280	58 19	325	67 42	370	77 5	415	86 28
11	2 12	56	11 36	101	20 59	146	30 22	191	39 45	236	49 8	281	58 31	326	67 54	371	77 17	416	86 40
12	2 24	57	11 48	102	21 11	147	30 34	192	39 57	237	49 20	282	58 43	327	68 6	372	77 29	417	86 52
13	2 36	58	12 0	103	21 23	148	30 46	193	40 9	238	49 32	283	58 55	328	68 18	373	77 41	418	87 4
14	2 48	59	12 12	104	21 35	149	30 58	194	40 21	239	49 44	284	59 7	329	68 30	374	77 53	419	87 16
15	3 0	60	12 24	105	21 47	150	31 10	195	40 33	240	49 56	285	59 19	330	68 42	375	78 5	420	87 28
16	3 12	61	12 36	106	21 59	151	31 22	196	40 45	241	50 8	286	59 31	331	68 54	376	78 17	421	87 40
17	3 24	62	12 48	107	22 11	152	31 34	197	40 57	242	50 20	287	59 43	332	69 6	377	78 29	422	87 52
18	3 36	63	13 0	108	22 23	153	31 46	198	41 9	243	50 32	288	59 55	333	69 18	378	78 41	423	88 4
19	3 48	64	13 12	109	22 35	154	31 58	199	41 21	244	50 44	289	60 7	334	69 30	379	78 53	424	88 16
20	4 0	65	13 24	110	22 47	155	32 10	200	41 33	245	50 56	290	60 19	335	69 42	380	79 5	425	88 28
21	4 12	66	13 36	111	22 59	156	32 22	201	41 45	246	51 8	291	60 31	336	69 54	381	79 17	426	88 40
22	4 24	67	13 48	112	23 11	157	32 34	202	41 57	247	51 20	292	60 43	337	70 6	382	79 29	427	88 52
23	4 36	68	14 0	113	23 23	158	32 46	203	42 9	248	51 32	293	60 55	338	70 18	383	79 41	428	89 4
24	4 48	69	14 12	114	23 35	159	32 58	204	42 21	249	51 44	294	61 7	339	70 30	384	79 53	429	89 16
25	5 0	70	14 24	115	23 47	160	33 10	205	42 33	250	51 56	295	61 19	340	70 42	385	80 5	430	89 28
26	5 12	71	14 36	116	23 59	161	33 22	206	42 45	251	52 8	296	61 31	341	70 54	386	80 17	431	89 40
27	5 24	72	14 48	117	24 11	162	33 34	207	42 57	252	52 20	297	61 43	342	71 6	387	80 29	432	89 52
28	5 36	73	15 0	118	24 23	163	33 46	208	43 9	253	52 32	298	61 55	343	71 18	388	80 41	433	90 4
29	5 48	74	15 12	119	24 35	164	33 58	209	43 21	254	52 44	299	62 7	344	71 30	389	80 53	434	90 16
30	6 0	75	15 24	120	24 47	165	34 10	210	43 33	255	52 56	300	62 19	345	71 42	390	81 5	435	90 28
31	6 12	76	15 36	121	24 59	166	34 22	211	43 45	256	53 8	301	62 31	346	71 54	391	81 17	436	90 40
32	6 24	77	15 48	122	25 11	167	34 34	212	43 57	257	53 20	302	62 43	347	72 6	392	81 29	437	90 52
33	6 36	78	16 0	123	25 23	168	34 46	213	44 9	258	53 32	303	62 55	348	72 18	393	81 41	438	91 4
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35	7 0	80	16 24	125	25 47	170	35 10	215	44 33	260	53 56	305	63 19	350	72 42	395	82 5	440	91 28
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37	7 24	82	16 48	127	26 11	172	35 34	217	44 57	262	54 20	307	63 43	352	73 6	397	82 29	442	91 52
38	7 36	83	17 0	128	26 23	173	35 46	218	45 9	263	54 32	308	63 55	353	73 18	398	82 41	443	92 4
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41	8 12	86	17 36	131	26 59	176	36 22	221	45 45	266	55 8	311	64 31	356	73 54	401	83 17	446	92 40
42	8 24	87	17 48	132	27 11	177	36 34	222	45 57	267	55 20	312	64 43	357	74 6	402	83 29	447	92 52
43	8 36	88	18 0	133	27 23	178	36 46	223	46 9	268	55 32	313	64 55	358	74 18	403	83 41	448	93 4
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45	9 0	90	18 24	135	27 47	180	37 10	225	46 33	270	55 56	315	65 19	360	74 42	405	84 5	450	93 28

log	Latit	log	Latit	log	Latit	log	Latit	log	Latit	log	Latit	log	Latit	log	Latit	log	Latit
gr.	gr. m	gr.	gr. m	gr.	gr. m	gr.	gr. m	gr.	gr. m	gr.	gr. m	gr.	gr. m	gr.	gr. m	gr.	gr. m
121	23 23	181	33 51	241	43 10	301	51 15	1	58 7	61	63 53	121	68 40	181	72 37		
122	23 34	182	34 1	242	43 18	302	51 22	2	58 14	62	63 58	122	68 45	182	72 40		
123	23 45	183	34 10	243	43 27	303	51 30	3	58 20	63	64 4	123	68 49	183	72 44		
124	23 56	184	34 20	244	43 36	304	51 37	4	58 26	64	64 9	124	68 53	184	72 47		
125	24 7	185	34 30	245	43 44	305	51 44	5	58 32	65	64 14	125	68 58	185	7 251		
126	24 18	186	34 40	246	43 53	306	51 52	6	58 39	66	64 19	126	69 2	186	72 54		
127	24 29	187	34 50	247	44 1	307	51 59	7	58 45	67	64 24	127	69 6	187	72 58		
128	24 40	188	35 0	248	44 10	308	52 6	8	58 51	68	64 30	128	69 10	188	73 1		
129	24 51	189	35 9	249	44 19	309	52 14	9	58 57	69	64 35	129	69 15	189	73 5		
130	25 1	190	35 19	250	44 27	310	52 21	10	59 3	70	64 40	130	69 19	190	73 8		
131	25 12	191	35 29	251	44 36	311	52 28	11	59 9	71	64 45	131	69 23	191	73 12		
132	25 23	192	35 38	252	44 44	312	52 36	12	59 16	72	64 50	132	69 27	192	75 15		
133	25 34	193	35 48	253	44 53	313	52 43	13	59 22	73	64 55	133	69 31	193	73 18		
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136	26 6	196	36 17	256	45 18	316	53 4	16	59 40	76	65 10	136	69 44	196	73 29		
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139	26 38	199	36 46	259	45 43	319	53 26	19	59 58	79	65 25	139	69 56	199	73 39		
140	26 49	200	36 55	260	45 51	320	53 33	20	60 4	80	65 30	140	70 0	200	73 42		
141	26 59	201	37 5	261	46 0	321	53 40	21	60 10	81	65 35	141	70 4	201	73 46		
142	27 10	202	37 14	262	46 8	322	53 47	22	60 16	82	65 40	142	70 8	202	73 49		
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144	27 31	204	37 33	264	46 24	324	54 1	24	60 27	84	65 50	144	70 16	204	73 56		
145	27 42	205	37 43	265	46 33	325	54 8	25	60 33	85	65 55	145	70 20	205	73 59		
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164	30 59	224	40 39	284	49 5	344	56 17	44	62 22	104	67 24	164	71 34	224	75 0		
165	31 10	225	40 48	285	49 13	345	56 24	45	62 27	105	67 29	165	71 38	225	75 3		
166	31 20	226	40 57	286	49 20	346	56 31	46	62 33	106	67 34	166	71 42	226	75 6		
167	31 30	227	41 6	287	49 28	347	56 37	47	62 38	107	67 38	167	71 46	227	75 9		
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175	32 51	235	42 17	295	50 29	355	57 29	55	63 21	115	68 14	175	72 15	235	75 33		
176	33 1	236	42 26	296	50 37	356	57 36	56	63 27	116	68 18	176	72 19	236	75 36		
177	33 11	237	42 35	297	50 45	357	57 42	57	63 32	117	68 23	177	72 22	237	75 39		
178	33 21	238	42 43	298	50 52	358	57 48	58	63 37	118	68 27	178	72 26	238	75 42		
179	33 31	239	42 52	299	51 0	359	57 55	59	63 43	119	68 32	179	72 30	239	75 45		
180	33 41	240	43 1	300	51 7	360	58 1	60	63 48	120	68 36	180	72 33	240	75 48		

lõg	Latit	lõg	Latit	lõg	Latit	lõg	Latit	lõg	Latit	lõg	Latit	lõg	Latit
gr.	gr. m	gr.	gr. m	gr.	gr. m	gr.	gr. m	gr.	gr. m	gr.	gr. m	gr.	gr. m
241	75 51	301	78 27	2	80 40	122	83 50	273	86 21	126	88 15		
242	75 54	302	78 31	4	80 44	124	83 53	276	86 23	132	88 17		
243	75 56	303	78 34	6	80 48	126	83 55	279	86 25	136	88 20		
244	75 59	304	78 38	8	80 52	128	83 56	282	86 28	141	88 22		
245	76 2	305	78 38	10	80 55	130	84 0	285	86 30	150	88 24		
246	76 5	306	78 41	12	80 59	132	84 3	288	86 32	156	88 26		
247	76 8	307	78 43	14	81 3	134	84 5	291	86 34	162	88 28		
248	76 11	308	78 46	16	81 7	136	84 8	294	86 36	168	88 29		
249	76 14	309	78 48	18	81 10	138	84 10	297	86 38	174	88 31		
250	76 16	310	78 50	20	81 14	140	84 13	300	86 40	180	88 33		
251	76 19	311	78 52	22	81 18	142	84 15	303	86 42	189	88 36		
252	76 22	312	78 55	24	81 21	144	84 17	306	86 44	198	88 38		
253	76 25	313	78 57	26	81 25	146	84 20	309	86 46	207	88 41		
254	76 28	314	78 59	28	81 28	148	84 22	312	86 48	216	88 43		
255	76 30	315	79 2	30	81 32	150	84 24	315	86 50	225	88 46		
256	76 33	31	79 4	32	81 35	152	84 26	318	86 52	234	88 48		
257	76 36	317	79 6	34	81 39	154	84 29	321	86 55	243	88 50		
258	76 39	318	79 8	36	81 42	156	84 31	324	86 57	252	88 52		
259	76 42	319	79 11	38	81 46	158	84 34	327	86 59	261	88 54		
260	76 44	320	79 13	40	81 49	160	84 36	330	87 1	270	88 56		
261	76 47	321	79 15	42	81 52	162	84 38	333	87 2	279	88 58		
262	76 50	322	79 17	44	81 56	164	84 40	336	87 4	288	89 0		
263	76 52	323	79 19	46	81 59	166	84 42	339	87 6	297	89 2		
264	76 55	324	79 22	48	82 2	168	84 45	342	87 8	306	89 4		
265	76 58	325	79 24	50	82 6	170	84 47	345	87 10	315	89 5		
266	77 1	326	79 26	52	82 9	172	84 49	348	87 11	324	89 7		
267	77 3	327	79 28	54	82 12	174	84 51	351	87 13	333	89 9		
268	77 6	328	79 30	56	82 15	176	84 53	354	87 15	342	89 10		
269	77 9	329	79 33	58	82 19	178	84 55	357	87 17	351	89 12		
270	77 11	330	79 35	60	82 22	180	84 58	360	87 18	360	89 13		
271	77 14	331	79 37	62	82 25	183	85 1	3	87 20	12	89 15		
272	77 16	332	79 39	64	82 28	186	85 4	6	87 22	24	89 17		
273	77 19	333	79 41	66	82 31	189	85 7	9	87 23	36	89 19		
274	77 22	334	79 43	68	82 34	192	85 10	12	87 25	48	89 20		
275	77 24	335	79 45	70	82 37	195	85 13	15	87 26	60	89 22		
276	77 27	336	79 48	72	82 40	198	85 16	18	87 28	72	89 24		
277	77 29	337	79 50	74	82 43	201	85 19	21	87 30	84	89 25		
278	77 32	338	79 52	76	82 47	204	85 20	24	87 31	98	89 27		
279	77 35	339	79 54	78	82 49	207	85 24	27	87 33	114	89 28		
280	77 37	340	79 56	80	82 52	210	85 27	30	87 34	130	89 30		
281	77 40	341	79 58	82	82 55	213	85 30	33	87 36	146	89 32		
282	77 42	342	80 0	84	82 58	216	85 33	36	87 37	162	89 33		
283	77 45	343	80 2	86	83 1	219	85 36	39	87 39	178	89 35		
284	77 47	344	80 4	88	83 4	222	85 38	42	87 40	194	89 36		
285	77 50	345	80 6	90	83 7	225	85 41	45	87 42	210	89 37		
286	77 52	346	80 8	92	83 10	228	85 44	48	87 43	240	89 39		
287	77 55	347	80 10	94	83 13	231	85 46	51	87 44	270	89 41		
288	77 57	348	80 12	96	83 15	234	85 49	54	87 46	300	89 43		
289	78 0	349	80 14	98	83 18	237	85 52	57	87 47	330	89 45		
290	78 2	350	80 16	100	83 21	240	85 54	60	87 49	360	89 46		
291	78 5	351	80 18	102	83 24	243	85 57	66	87 51	36	9 48		
292	78 7	352	80 20	104	83 27	246	85 59	72	87 54	72	89 49		
293	78 10	353	80 22	106	83 29	249	86 2	78	87 56	108	89 51		
294	78 12	354	80 24	108	83 32	252	86 4	84	87 59	144	89 51		
295	78 15	355	80 25	110	83 35	255	86 7	90	88 1	180	89 52		
296	78 17	356	80 28	112	83 37	258	86 9	96	88 4	240	89 55		
297	78 19	357	80 30	114	83 40	261	86 11	102	88 6	360	89 56		
298	78 22	358	80 32	116	83 43	264	86 14	108	88 9	180	89 57		
299	78 24	359	80 34	118	83 45	267	86 16	114	88 11	360	89 58		
300	78 27	360	80 36	120	83 48	270	86 18	120	88 13	180	89 59		

The eighth Rumb from the Meridian. *East. West.*

Latit	1 gr. of lõ	diff.
gr. m	m. ſ	thi ſ. thi
0 10	59 59	59 0 1
0 20	59 59	56 0 3
0 30	59 59	52 0 4
0 40	59 59	45 0 7
0 50	59 59	37 0 8
1 0	59 59	27 0 10
1 10	59 59	15 0 12
1 20	59 59	2 0 13
1 30	59 58	45 0 16
1 40	59 58	29 0 17
1 50	59 58	9 0 20
2 0	59 57	48 0 21
2 10	59 57	26 0 22
2 20	59 57	1 0 25
2 30	59 56	34 0 27
2 40	59 56	6 0 28
2 50	59 55	36 0 30
3 0	59 55	4 0 32
3 10	59 54	30 0 34
3 20	59 53	55 0 35
3 30	59 53	17 0 38
3 40	59 52	38 0 39
3 50	59 51	57 0 41
4 0	59 51	14 0 43
4 10	59 50	29 0 45
4 20	59 49	43 0 46
4 30	59 48	54 0 49
4 40	59 48	4 0 50
4 50	59 47	12 0 52
5 0	59 46	18 0 54
5 10	59 45	22 0 56
5 20	59 44	25 0 57
5 30	59 43	26 0 59
5 40	59 42	24 1 2
5 50	59 41	21 1 3
6 0	59 40	17 1 4
6 10	59 39	10 1 7
6 20	59 38	2 1 8
6 30	59 36	52 1 10
6 40	59 35	39 1 13
6 50	59 34	26 1 13
7 0	59 33	10 1 16
7 10	59 31	52 1 18
7 20	59 30	33 1 19
7 30	59 29	12 1 21
7 40	59 27	49 1 23
7 50	59 26	24 1 25
8 0	59 24	58 1 26
8 10	59 23	30 1 28
8 20	59 21	59 1 31
8 30	59 20	27 1 32
8 40	59 18	54 1 33
8 50	59 17	18 1 36
9 0	59 15	41 1 37
9 10	59 14	1 1 40
9 20	59 12	20 1 41
9 30	59 10	38 1 42
9 40	59 8	53 1 45
9 50	59 7	7 1 46
10 0	59 5	18 1 49

Latit	l.g.of lō	diff.	Latit	l.g of lō	diff.	Latit	l g of lō	diffe	Latit	l.g. of lō	diffe
gr. m	m. ſ. th	ſ.thi	gr. m	m. ſ. thi	ſ. th	gr. m	m. ſ thi	ſ. th	gr. m	m. ſ.t hi	ſ. th
10 0	59 3 28	1 50	20 0	56 19 18	3 36	30 0	51 52 26	5 15	40 0	45 51 1	6 45
10 20	59 1 37	1 51	20 20	56 15 40	3 38	30 20	51 47 10	5 16	40 20	45 45 15	6 46
10 30	58 59 43	1 54	20 30	56 12 1	3 39	30 30	51 41 52	5 18	40 30	45 37 28	6 47
10 40	58 57 49	1 54	20 40	56 8 20	3 41	30 40	51 36 32	5 20	40 40	45 30 39	6 49
10 50	58 55 50	1 59	20 50	56 4 38	3 42	30 50	51 31 11	5 21	40 50	45 23 49	6 50
11 0	58 53 51	1 59	21 0	56 0 53	3 45	31 0	51 25 48	5 23	41 0	45 16 57	6 50
11 10	58 51 51	2 0	21 10	55 57 7	3 46	31 10	51 20 24	5 24	41 10	45 10 4	6 53
11 20	58 49 48	2 3	21 20	55 53 20	3 47	31 20	51 14 58	5 26	41 20	45 3 10	6 54
11 30	58 47 44	2 4	21 30	55 49 30	3 50	31 30	51 9 30	5 28	41 30	44 56 14	6 56
11 40	58 45 38	2 6	21 40	55 45 39	3 51	31 40	51 4 1	5 29	41 40	44 49 17	6 57
11 50	58 43 30	2 8	21 50	55 41 48	3 51	31 50	50 58 31	5 30	41 50	44 42 19	6 58
12 0	58 41 20	2 10	22 0	55 37 52	3 56	32 0	50 52 58	5 33	42 0	44 35 19	7 0
12 10	58 39 8	2 12	22 10	55 33 55	3 57	32 10	50 47 25	5 33	42 10	44 28 18	7 1
12 20	58 36 55	2 13	22 20	55 29 58	3 57	32 20	50 41 47	5 36	42 20	44 21 16	7 2
12 30	58 34 40	2 15	22 30	55 25 58	4 0	32 30	50 36 13	5 36	42 30	44 14 12	7 4
12 40	58 32 23	2 17	22 40	55 21 57	4 1	32 40	50 30 34	5 39	42 40	44 7 7	7 5
12 50	58 30 4	2 19	22 50	55 17 54	4 3	32 50	50 24 54	5 40	42 50	43 0 0	7 7
13 0	58 27 44	2 20	23 0	55 13 49	4 5	33 0	50 19 13	5 41	43 0	43 52 52	7 8
13 10	58 25 22	2 22	23 10	55 9 43	4 6	33 10	50 13 30	5 43	43 10	43 45 43	7 9
13 20	58 22 58	2 24	23 20	55 5 35	4 8	33 20	50 7 45	5 45	43 20	43 38 33	7 10
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13 40	58 18 4	2 28	23 40	54 57 14	4 11	33 40	49 56 12	5 47	43 40	43 24 8	7 13
13 50	58 15 35	2 29	23 50	54 53 1	4 13	33 50	49 50 23	5 49	43 50	43 16 53	7 15
14 0	58 13 4	2 31	24 0	54 48 46	4 15	34 0	49 44 32	5 51	44 0	43 9 37	7 16
14 10	58 10 31	2 32	24 10	54 44 29	4 17	34 10	49 38 40	5 52	44 10	43 2 20	7 17
14 20	58 7 56	2 35	24 20	54 40 11	4 18	34 20	49 32 46	5 54	44 20	42 55 2	7 18
14 30	58 5 20	2 36	24 30	54 35 52	4 19	34 30	49 26 51	5 55	44 30	42 47 42	7 20
14 40	58 2 42	2 38	24 40	54 31 30	4 22	34 40	49 20 55	5 56	44 40	42 40 21	7 21
14 50	58 0 2	2 40	24 50	54 27 07	4 23	34 50	49 14 56	5 59	44 50	42 32 59	7 22
15 0	57 57 20	2 42	25 0	54 22 42	4 25	35 0	49 8 57	5 59	45 0	42 25 35	7 24
15 10	57 54 36	2 44	25 10	54 18 16	4 26	35 10	49 2 56	6 1	45 10	42 18 10	7 25
15 20	57 51 51	2 45	25 20	54 13 48	4 28	35 20	48 56 53	6 3	45 20	42 10 44	7 26
15 30	57 49 4	2 47	25 30	54 9 18	4 30	35 30	48 50 49	6 4	45 30	42 3 16	7 28
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15 50	57 43 25	2 50	25 50	54 0 14	4 33	35 50	48 38 36	6 7	45 50	41 48 18	7 30
16 0	57 40 33	2 52	26 0	53 55 40	4 34	36 0	48 32 28	6 8	46 0	41 40 46	7 32
16 10	57 37 38	2 55	26 10	53 51 34	4 37	36 10	48 26 18	6 10	46 10	41 33 14	7 32
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CHAP. X.

The uſe of this Table of Rumbs.

THe eſpecial uſe of this Table is for the true drawing of the Rumbs in the Globe and in the Chart, which ſome (with a name aſtoniſhing with an emptie ſound) call Paradoxal: but to ſpeak plain Engliſh, it is nothing elſe but a Chart, whoſe center is the Pole, and may beſt be made after the kinde of projection uſed by *Gemma Friſius* in his general Aſtrolabe: wherein the Meridians will be right lines paſſing by the center, and the Parallels peripheries of a circle: ſuppoſing one halfe of the Sphærical ſuperficies of the Terreſtrial Globe to be projected into the plaine of the Equinoctial. Whoſe principal uſe may be in our Northerly Navigations and diſcoveries, wherein the Rumbs may moſt eaſily and truly be drawn by help of this Table, thus: Having an Index hanged upon the center, and garduated with degrees of Latitude, with figures ſet to every fifth or tenth degree, beginning at the Equinoctial: having alſo divided the Equinoctial into degrees of Longitude, beginning at the firſt Meridian, lay the Index to every degr. of Longitude in order one after another; looking alwaies withall in this Table, the Latitudes of the Rumb you deſire to deſcribe, and at the ſame Latitudes found in the fiducial line of the Index, make pricks in the Chart, for by theſe pricks, the Hæliſphærical line or Rumb deſired muſt be drawn.

After the ſame manner muſt you work with the Globe, haveing firſt truly hanged it upon his Poles within his Meridian divided into degrees, and ſubdivided alſo into ſmaller parts (if room will ſerve) with numbers ſet to every fifth, or tenth degree from the Equinoctial to the Pole, and then proceeding in all points, as before you did, with the Chart, only uſing the Meridian in ſtead of the Index.

Hereby alſo the Rumbs may moſt exactly be diſcribed in thoſe diſtorted heart-formed maps of *Orontius* and *Vopelius*, or in any other amongſt *Ptolemies* or *Ortelius* his Geographical Tables, or any elſe whatſoever, ſo it be firſt diſtinguiſhed by Meridians and Parallels, whereby the Longitude and Latitude of any point aſſigned therein may be readily found; ſeeing it may eaſily be knowne out of this Table by what points of Longitude and Latitude each rumbe muſt be drawn from the Equinoctial to the Pole almoſt. But thoſe two kindes of projection before mentioned,

ned, I mean of the Nautical Planisphære, and *Gemma Frisius* his Astrolabe, are such as of all others doe best represent in a plain, the true formes of all places that are upon the Spharical face of the earth.

The Table of eighth Rumb serveth to shew how many minutes, seconds and thirds of one degree of the Equinoctial, are contained in one degree of Longitude for every tenth minute of Latitude: whereby the whole Table of Rumbs may be made and examined more truly, and easily, then by that of *Appian*, lately set forth by *Simon Stevin* in his *Hypomnemata Mathemat.*

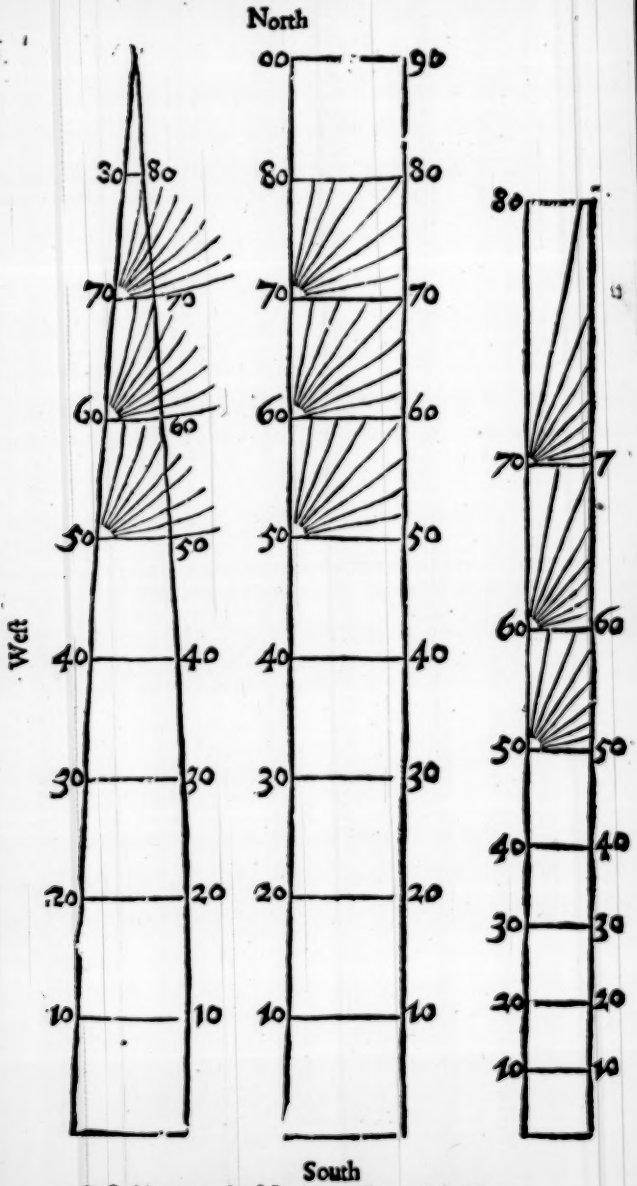
CHAP. XI.

A most plaine and sensible demonstration of the agreement of the Nautical Planisphære, before described, with the Globe and of the disagreement of the common Sea-chart from them both.

HAving thus shewed the manifold uses of the Table of Latitudes, aswell for the true graduating of Sea-charts both generall and particular, with degrees of Latitude increasing in their due proportion, as also for the making of the table of Rumbes, together with the use thereof; I will now come againe to the matter, and marke principally intended and aimed at in this first book, and shew how greatly the common Sea-chart (with Parallel Meridians and degrees of Latitude every where equal) doth differ from the truth, as also how well the Chart, before described, agreeth with the same; which may most manifestly appeare by comparing together these three figures following, whereof the first is in all points answerable to a part of a Sphærical superficies, contained betwixt two Meridians, differing in Longitude ten degrees, and extended from the Equinoctial to the Pole. The second containeth ten degrees in Longitude, and 90 degrees from the Equinoctial in Latitude, of the common Sea-chart with equidistant Meridians and degrees of Latitude every where equal. The third containeth 10 degrees in Longitude, and 80 in Latitude of the Nautical Planisphære, truly described with Meridians in all places æquidistant, and degrees of Latitude increasing proportionally towards the Pole, as before we have shewed.

Now all the other parts of the Globe or Charts are like unto

these;



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theſe; therefore what agreement or diſagreement is found in theſe parts muſt needes be alſo in their wholes. The firſt figure is a part of the Globe, and therefore in all things ſheweth the very truth: therefore we make it the rule to examine the reſt by, for ſo farre forth as they agree with it, they are true, and as much as they differ from it, they are falſe. Now therefore let us bring them to examination.

If there be two places differing in Longitude and Latitude 10 degrees (that which hath the greater Latitude being more to the Eaſtwards) the ſecond figure (as you ſee) maketh them lie each from other Northeaſt and Southweſt, in what Latitude ſoever they be ſituate, either neerer or further from the Equinoctial, as in 50 and 60, or in 60 and 70; or in 70 and 80 degrees of Latitude. But in the firſt and third figure, theſe places ſhall beare almoſt Northeaſt and Southweſt each from other, at the Equinoctial onely. And one place being ſituate in 50, and the other in 60 degrees of Latitude, they ſhall lie one from another Northeaſt and by North, and almoſt halfe a point Northerly. In 60 and 70 degrees of *L*atitude they lie almoſt North Northeaſt: in 70 and 80 they beare each from other ſcarce ſo much as North and by Eaſt. Therefore the common Sea-Chart, in ſhewing how one of thoſe places beareth from another, erreth in the firſt one point of the Compaſſe and almoſt an halfe; in the ſecond, two whole points almoſt; but in the third, more then three whole points. Neither is it poſſible to avoide theſe ſo groſſe and intollerable errors (if the Rumbs be right lines, and the degrees of *L*ongitude and *L*atitude every where equal) but wee muſt needes fall into other errors as groſſe as theſe, either in the difference of *L*ongitudes, or in the difference of *L*atitudes, or in the reſpective ſituation, which they commonly call, the lying or bearing of them one from another. as may moſt plainly appeare by comparing the common Sea-Chart and the Globe together. But in this Nauticall planiſphære heretofore deſcribed, all theſe errors are avoided, aſwell in the *L*ongitudes and *L*atitudes, as alſo in the directional diſtances and reſpective ſituations of all places, each from other according to the points of the Compaſſe, as by like compariſon of it with the Globe, will be moſt manifeſt.

CHAP. XII.

The use of this Planisphaere.

OF the use of this Planisphære much more might be written then now I have leisure or cause to set down, a great part hereof being in such sort to be performed, as hath bin heretofore accustomed in the ordinarie Sea-Chart, saving that this Nautical planisphære generally bringeth you to more certaine truth in conclusion, then the ordinarie Chart hitherto hath done, or possibly can doe. Something notwithstanding (for the better satisfaction of the Reader) I thought meete at this time to adde to the former treatise, especially in those points which may be most serviceable for Sea men, and wherein the use of this Nautical Planisphære differeth from the use of the common Sea-Chart, heretofore ordinarily practised.

To know upon what point of the Compasse one place in this Chart lieth from another, try with your Compasses from what Rumb both places have equal distance, which may be found truly enough, for the Mariners use, for the most part, by estimation onely. But if you would be precise, doe thus: Draw a straight line by both places, for a line Parallel to it from the center of the next Rose or Flie (as it is called) is the Rumb of those two places, shewing upon what point of the Compasse you must goe from the one to the other.

Or thus, (if you list not draw any lines upon your Chart) lay the edge of a long ruler (reaching overthwart the Chart) to both places: take with your Compasses the distance of the center of the next Flie from the edge of the ruler, then guiding and carrying one foote along by the edge of the ruler, leade the other foote Parallel-wise (that is, keeping it alwaies equally at that distance from the ruler) for so it sheweth you how those places lie one from another.

The distance of two places (as the Mariners commonly take it, and measure it in their Charts) is the segment or part of the Rumbe contained betweene them; which how much it is in the ordinarie measure of leagues, shall truly be found out by this Planisphære, thus.

If both places have the same Latitude, take with your Compasses the length of a degree of the Meridian at that Latitude (take

(take halfe the degree above, and halfe beneath that Latitude) for ſo oft as you ſhall finde that lenght betweene the two places, ſo many ſcore leagues are there betwixt them. If the diſtance be great, for the more expedition, you may take five times the length of that degree, and counting it for an hundred leagues, proceed as before.

If both places have not the ſame Latitude, the Equinoctial alſo not comming betweene them, ſubtract the leſſer Latitude out of greater; but if the Equinoctial come betwixt them, adde both Latitudes together, ſo have you the difference of Latitude betweeene both places.

Now if both places have the ſame Longitude, ſo many degrees as there is in the difference of Latitude, ſo many ſcore leagues is the diſtance.

But if they differ alſo in Longitude as well as in Latitude, looke how many degrees the difference of Latitude containeth, ſo many degrees of the Equinoctial take with your Compaſſes, and leading one foote in the Equinoctial, move forwards the other alſo Parallel-wiſe, keeping alwaies that diſtance, till it croſſe the Rumb of thoſe two places, in ſuch ſort, that one foote reſting in that croſſing, the other carried about, may but onely touch the Equinoctial. Then having taken with your Compaſſes the ſegment or part of that Rumb betweene that croſſing and the Equinoctial, ſet both feete in the Equinoctial, and ſee how many degrees are contained betwixt them, for ſo many ſcore leagues is the diſtance of thoſe two places.

Or if that ſegment of the ſaid Rumb be greater then well can be taken with the Compaſſes, take the length of five degrees of the Equinoctial, between the feet of your compaſſes, and looke how oft you can find that length in the ſegment aforeſaid of the Rumb: for ſo many hundred leagues is the diſtance of thoſe two places.

The demonſtration hereof cannot be obſcure to him that well conſidereth the Geometrical reaſon of the projection, and making of this Nauticall planiſphære, before ſet down in the ſecond Chapter; from whence it followeth, that becauſe the ſphæricall ſuperficies (whereof this planiſphære is conceived to be Geometrically made) extendeth it ſelfe every way equally, at every point of Latitude betwixt the Equinoctial and Pole, till it applie and joyne it ſelfe round about to the concavitie of the circumſcribed Cylinder, therefore the ſegments of the Meridian, and of any other Rumb contained betwixt any the ſame two Parallels, muſt needs increaſe in one and the ſame proportion.

And consequently, as often as the segment of a Meridian betweene any two Parallels, is contained in the segment of any Rumb intercepted betwixt the same Parallels in the Globe, so often is the like segment of a Meridian contained in the segment of the same Rumb intercepted betweene the Parallels correspondent in this planisphære. Therefore (supposing the said segment of the Meridian in this planisphære, to be divided into so many equal parts as it containeth degrees) it followeth that so often as one of these parts is contained in the segment of the Rumb aforesaid in this planisphære, so many score leagues is the distance of the two places set at the ends of that segment.

Now it is manifest, that by these three segments, that is the segment of the Rumb betweene the two places the segment of the Meridian betwixt one of the places, and the Parallel of the other (that is, the difference of Latitude) and the segment of the Parallel contained betwixt one of these places, and the Meridian of the other (which is the difference of Longitude) I say it is manifest, that by these three segments a right angled Triangle is made, because the segments of the Meridian and Parallel (which are two sides of this Triangle) include a right angle.

Againe it is plaine, that taking with your Compasses so many degrees of the Equinoctial as are contained in the difference of Latitude, then guiding one foote in the Equinoctial, and carrying forwards the other Parallel wise, till it crosse the Rumb of those two places in such sort that one foote of the Compasses being set in that crossing, the other moved about, may but only touch the Equinoctial: and lastly, drawing from that crossing a line perpendicular to the Equinoctial: It is plaine, I say, that by this perpendicular and the two segments (one of the Equinoctial, betweene this perpendicular and the Rumb; the other of the Rumb, betweene the perpendicular and the Equinoctial:) by these segments, I say, and the said perpendicular, there is comprehended another right angled Triangle: which by the 14. *e* 4. *&* *c* 3. *e*.7 *Ram.* Is like to the former right angled Triangle, because two angles, of them both are equal, that is, the right angles, and the angles of the same Rumb. In the last of these Triangles, the side perpendicular to the Equinoctial, is proportional to the difference of Latitude, and the segment of the Rumb betweene the end of this perpendicular and the Equinoctial, is proportional to the segment of the same Rumb contained betwixt the two places. Therefore by the 2 *p* 6. *&* 17 *p*. 11 *Eucl.* Because the line perpendicular to the Equinoctial, containeth so many equal degrees

of

of the Equinoctial, as there are equal parts in the difference of Latitude (that is) ſo many as there are degrees in the difference of Latitude theſe equal parts alſo of the perpendicular and difference of Latitude are proportional. Whereof it followeth, that ſo oft as one of theſe equal parts of the difference of Latitude is contained in the ſegment of the Rumb betwixt the two places (which before we ſhewed to be ſo oft as a degree of the Meridian in the Globe is contained in the ſegment of the Rumbbetwixt the ſame places in the Globe) ſo oft is one of the ſaid equal parts of the perpendicular aforeſaid (that is a degree of the Æquinoctial) contained in the ſegment of the ſame Rumb betweene the foreſaid croſſing or end of the perpendicular, and the Æquinoctial. Therefore look how many degrees of the Æquinoctial there are found in the ſegment of the Rumb of the two places, ſo many ſcore leagues is the diſtance of thoſe two places which was to be demonſtrated.

Thus have you a way infallible to find out the diſtance betweene any two places meaſured in their Rumb: which becauſe it is then onely their true diſtance (that is the ſhorteſt ſpace betwixt them upon the ſuperficies of the Terreſtriall Globe) when both places lie North and South each from other, or Eaſt and Weſt, having no Latitude, as under the Æquinoctial, whereas otherwiſe the ſegment of the Rumb betweene the two places is alwaies greater then the true diſtance (yea ſometime by halfe and more, in places far Northward, or Southward) I thought good alſo here to ſet down the way to find out the true diſtance of any two places, according to the arch of a great circle drawn betweene them, wherein I have been, and yet am publikely charged with my promiſe, and meane at this time to diſcharge my ſelfe thereof.

The true diſtance betweene two places is the arch of a great circle contained betwixt them, which is thus to be found out.

If both places have no Latitude (as when they are both under the Æquinoctial) and one of them alſo no Longitude, the Longitude of the other being leſſe, or not more then 180 degrees; the Longitude is the diſtance;

But if the Longitude be greater then 180 degrees ſubtract it out of 360; the remainder is the diſtance.

If both places have either none, or the ſame Longitude (as when they are in the ſame ſemicircle of the Meridian betweene the Poles) and one of them onely have Latitude; that Latitude is

the distance. But if both places agreeing in *Longitude* have *Latitudes* also of like denomination (as both Northerly, or both Southerly) subtract the lesser *Latitude* out of the greater, the distance remaineth: If one place have Northerly *Latitude*, and the other Southerly, adde them together; for the summe is the distance.

If one or both places have atitude, *L*and differ also in *Longitude*: in a great circle divided exactly into degrees (with figures set to every fifth or tenth degree) note the *Longitudes* of both places.

Now if one place only have *Latitude*, draw a diameter from the *Longi* tude thereof, noted in the circle, and with your Compasses take so many degrees and minutes in the same circle, as that Latitude containeth: then setting one foote of the Compasses in the Longitude of that place, with the other make a pricke in the circle, which may be called the point of Latitude. From this point draw a line perpendicular, crossing the diameter drawn from the Longitude of that place. Take with your Compasses the distance of this crossing, from the point of the other places Longitude, noted in the circle, and leaving one foote in the said crossing, with the other make a pricke, in the foresaid diameter: take the distance of this pricke from the point of Latitude noted in the circle. Then setting one foote of the Compasses in that point of the circle where the degrees begin to be numbred, the other foote extended that way, which the numbers proceed, shall shew you in the circle the distance of the places.

Take for example the Citie of *London*, and Saint *Thomas* Iland, which lieth right under the Æquinoctial line, in 32 degrees of Longitude. The *Longitude* of *London* admit to be 22 degrees, the *Latitude* 51 degrees, 32 minutes. Marke the *Longitudes* of Saint *Thomas* Iland and of *London* with A and B. From the *Longitude* of *London* (because *London* hath also *Latitude*) draw the diameter B C. Having taken with the compasses the *Latitude* of *London* in the circle, set one foote in B, and with the other make the prick E in the circle, and draw the perpendicular E F, crossing the diameter B C at F. Make F G equal to F A, which is the distance of Saint *Thomas* Iland from the line of *Londons Latitude*. Then G E shall be the line subtending the distance of those two places. Taking therefore the length of G E with the Compasses, and setting one foote in H (where the degrees begin) the other stretched forwards in the circle, will point you out the distance of Saint *Thomas* Iland and *London*, 52 degrees of a

great

great circle, and about one halfe, that is, 1050 leagues, or 3150 English miles.

If both places have Latitude, do the like for both places as before you did for the one place having Latitude, till you have crossed both diameters with perpendiculars: then take with your Compasses the distance of those crossings. Now if both their Latitudes be of one denomination (that is, both Northerly or both Southerly) and equal, set one foote of the Compasses where the degrees begin to be numbred in the circle, and the other foote extended therein that way which the numbers succeede, will shew you the distance.

As for example, *London* and Cape *Blanco* (neere the coast of New-found land) have both Northerly and almost equal Latitudes of 51 degrees, 32 minutes. Having therefore drawn as well the diameters B C and D L from B, determining the Longitude of *London* (*viz.* 22 degrees) and from the point of the Longitude of Cape *Blanco* (which admit to be 331 degrees, as also the perpendiculars or lines of both their Latitudes, EF, and KL, (as before was shewed) crossing the diameters in F and L: the distance F L taken with the Compasses, and translated into the circle (as in the former example) will shew you the distance of Cape *Blanco* from *London*, to be almost 31 degrees, of a great circle that is 620 leagues, or 1860 miles.

If the Latitudes be not both equal, and also of one denomination, leaving one foote of the Compasses in the crossing of the line or perpendicular descending from the point of the greater Latitude, with the other foote make a pricke in the same diameter, wherein that crossing is: then if the Latitudes be both of one denomination, take with the Compasses the length of the perpendicular or line drawn from the point of the lesser Latitude: and setting one foote in the point of the greater Latitude, with the other make a pricke in the perpendicular descending from it, that is, in the line thereof: Take the distance of this pricke from the former, made in the diameter: This distance transferred into the circle (as in the first example) will give you the distance of the places given.

As *London* and *Hierusalem* have both Northerly and unequal Latitudes, *Hierusalems* Latitude being onely 32 degrees. First therefore note in the circle both their Longitudes: the Longitude of *London* (*viz.* 22 degrees) as before with B: The Longitude of *Hierusalem* (68 degrees) note with M: Let the perpendicular or the lines of the Latitudes of *London* and *Hierusalem*, E F, and

and N O be drawn as in the former examples Make F P equal to O F, and P Q equal to N O: The ſpace betwixt P and Q taken with the Compaſſes, and then both feet ſet in the circle (in ſuch ſort as in the firſt example was ſhewed) ſhall containe between them the deſired diſtance of *Hieruſalem* from *London*, 38 degrees, and about ¾, that is 775 leagues, which are 2325 miles.

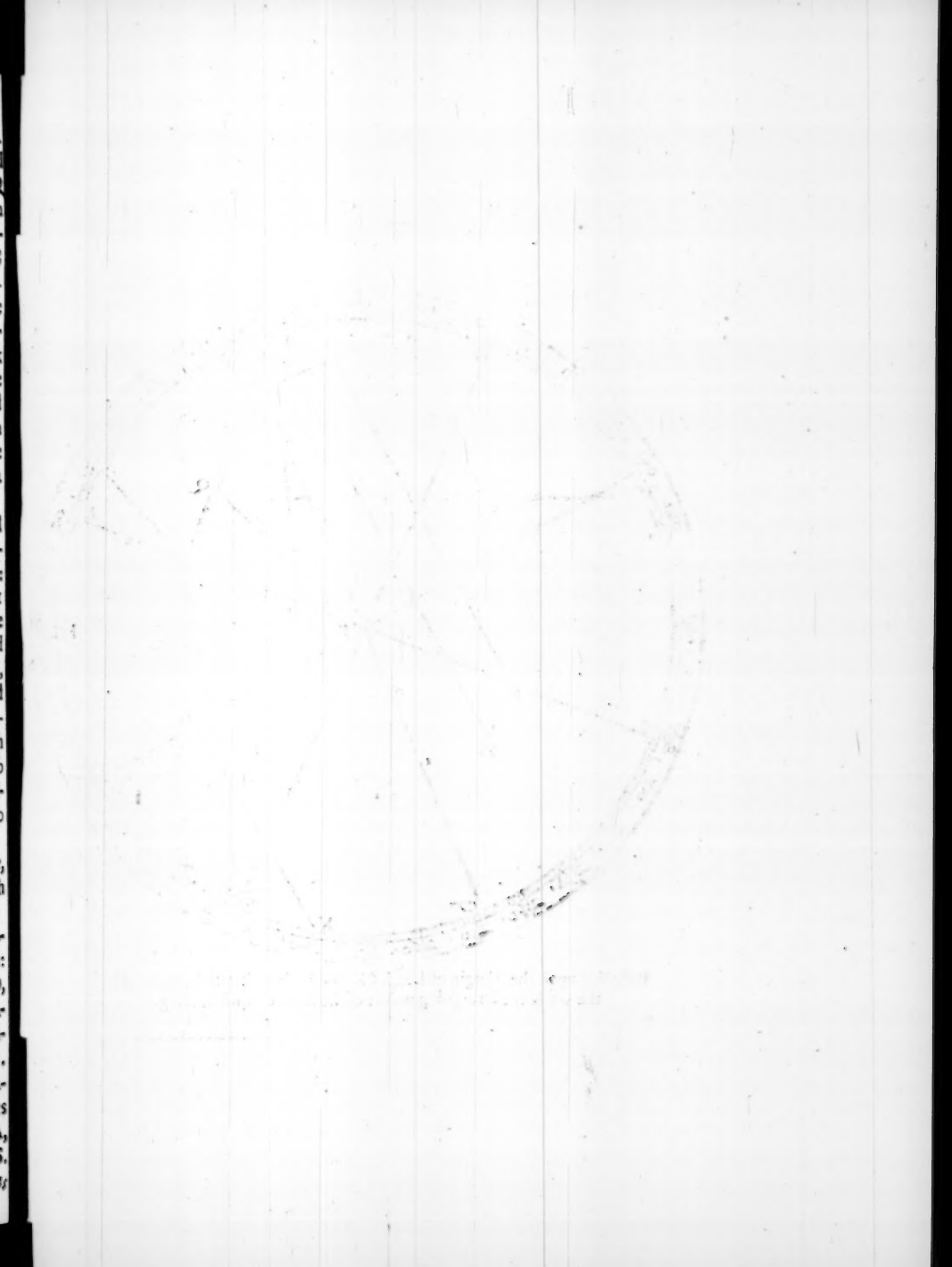
But if the Latitudes be of divers denominations, (that is, one Northerly, and the other Southerly) continue forth the perpendicular (that croſſeth the diameter, wherein the foreſaid prick was made) till it be equal to both perpendiculars, that is to the ſines of both Latitudes. The diſtance of the end of this continued perpendicular from the pricke aforeſaid in the diameter, taken with the Compaſſes, and tranſlated into the graduated peripherie of the circle (as before) will ſhew you how many degrees of a great circle are contained between both places.

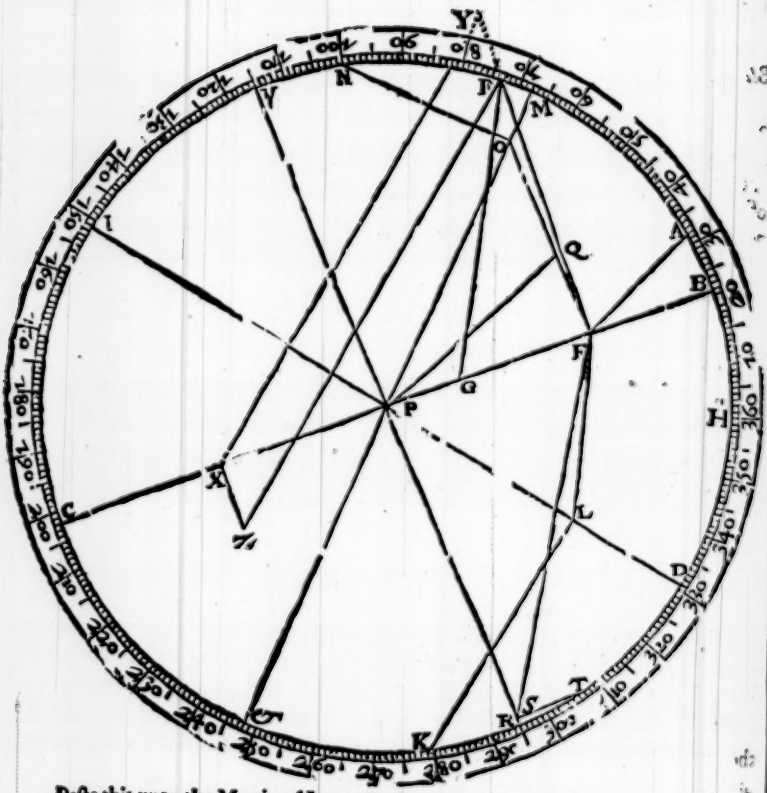
To ſhut up this matter with one example, ſuppoſe you would know how farre *Cuſco* in *Peru* is from *London*. Let the Longitude of *Cuſco* be 295 degrees, the Latitude 11 degrees Southerly: The Longitude of *London*, as before, 22 degrees the Latitude 51 degrees, 32 minutes From both theſe Longitudes noted in the circle with B and R, draw the diameters, as before, B C, and R V: as alſo the perpendiculars or ſines of their Latitudes E F, and T S: Make F X equal to F S, the diſtance of thoſe ſines. and E Y equal to S T the ſine of *Cuſcoes* Latitude. Take the diſtance X Y between the feet of the Compaſſes, and ſet them both in the circumference of the circle, as in the firſt example, ſo ſhall you find that there are betwixt *London* and *Cuſco* almoſt 97 degrees, of a great circle that is 1940 leagues, or 5820 miles.

If you had rather keepe within the compaſſe of the circle, make the perpendicular X Z equal to S T, and proceede with E Z as you did before with X Y.

He that deſireth a demonſtration of the former rules, muſt ſuppoſe the circle A B H D R and C to be the Equinoctial circle: let him alſo underſtand the ſines of Latitude E F, K L, N O, T S, to ſtand perpendicularly erect from their diameters of Longitude B C, D I M and V R, and from the plain of the Æquinoctial; and conſequently by the 3 *e.* 21. *Ram.* or 4 *pr.* 11. *Euel.* from the lines F A F L, F O, F S, which lines are imagined to be in the plain of the Æquinoctial. and are the diſtances of the ſines of Latitude. Therefore if F G be made equal to F A, (which is a line drawn in the plain of the Æquinoctial from S.

Thomas





Paſte this upon the Margin of Letter N. fol. 65. ſo as it may ly open all the while the fore-going matter of the ſame Chap. is reading.

Thomas Iland to the ſine of *Londons* Latitude) E G muſt needs be equal to the line ſubtending the diſtance of *London* and S. *Thomas* Iland by the 2.*e*.7.*Ra*.4.26.pr.1.*Encl.*

Alſo, becauſe all the ſines of Latitude (being perpendicular to the ſame plain of the Æquinoctial) are Parallels, by the 5.*e* 21. *Ram*.6.pr.11.*Encl.* Therefore by the 11.*e* 2.*Ram*.or 35.d.1. *Encl.* F L is the line ſubtending the diſtance of *London* and *Cape Blanco.*

Again becauſe F P whereto E F is perpendicular is made equal to F O, (the diſtance of the ſines of *London* and *Hieruſalem*, to which (diſtance) E F is alſo perpendicular in the Globe) and E Q alſo equal to N O: Therefore F Q being the difference of the ſines of *Londons* and *Hieruſalems* Latitudes, there muſt needs be the ſame diſtance betwixt P and Q that there is between the tops of the ſines of *Hieruſalems* and *Londons* Latitudes in the Globe.

Laſtly, F X being equal to F S (the diſtance of the ſines of Latitude of *London* and *Cuſco* in *Peru*) and X Z perpendicular to F X, and equal to S T the ſine of *Cuſcoes* Latitude: as E F is the ſine of *Londons* Latitude and perpendicular to the ſame line X F: E Z (to which X Y is equal by the 6.*c* 12.*e* 5 *Ram*.33.pr.1. *Encl.* Y E being equal and Parallel to X Z) muſt needs be equal to a ſtreight line extended within the Globe between the points of Latitude of *Cuſco* and *London.*

Now out of this demonſtration it were an eaſie matter (if any liſt take the pains to be ſo curious) to find out the diſtance of any two places Arithmetically by the doctrine of Triangles, having alwaies two ſides given, which are the ſines of the complements of the Latitudes of the two places, as O P: F P: *L* P, F P: R P, F P: A P, F P: together with the angle contained between them, that is the difference of their Longitudes: whereby F A: F O: F *L*: F S, the diſtances of the ſines of *L*atitude being found by the 2,3,4,5, *Copernic. de Triang. planis*, the lines alſo ſubtending the diſtances of the places may moſt eaſily be found by the 3. *Copernic. de Triang. plan.* For the ſquares of the diſtance of the ſines and of the difference of the ſines of their *L*atitudes (if both be Northerly or both Southerly) or of the ſum of the ſines of their *L*atitudes (if one be Northerly another Southerly) are equal to the ſquare of the line ſubtending the diſtance of the places 5.*e* 12. *Ram*.47.pr.1.*Encl.*

With no leſſe facilitie alſo by help of the former Tables, and the Canon of Triangles, any two places being given, there may

Arithmetically and most exactly be found out, first, by their Longitudes and Latitudes, the Rumb, and distance measured in the Rumb: secondly, by their distance, and Latitudes, the Rumb and difference of Longitude: thirdly, by their Rumb, and Latitudes, the distance and difference of Longitude: fourthly, by their Longitudes, Rumb, and one Latitude, the other Latitude and Distance: fiftly, by the Rumb distance and one Latitude, the other Latitude, and the difference of Longitude; or any other Nauticall or Geographicall probleme that by the Chart may mechanically be performed: and the whole Art of Navigation Arithmetical (as some call it) may as easily be practised: So as having only the Longitudes and Latitudes of the places (by which, and to which you are to Sail) set down in a Table, you may by Arithmetical Calculation only (if you list take the pains without any Chart, Map or Globe, shew the Course and Distance from any place to other: and so give most exact direction for the performance of an whole Voyage to any known place assigned, how oft soever you have traversed or been tossed this way, and that way, by reason of scant, violent, or contrarie winds, or any other occasion.

But seeing the first grounds of this Art, that is, the observations of the Latitudes, but especially of the Courses at Sea, can not but be far from such exquisite truth as is to be found in those Arithmetical operations: how exact soever you be in the rest of the means, you can look for no more truth in conclusion then such as is answerable to the first grounds and principles, out of which the conclusion is gathered. So as the Mariner shall not need to trouble himself any further herewith, but only to cast up his accounts upon the Chart truly made (as before is shewed) which of all other is most fit and ready for his ordinary use. Now therefore it may be sufficient, only to shew how the former Problems may mechanically be performed upon the Nauticall Planisphære before described.

1. By the longitudes and latitudes of two places, to find the rumb and distance.

First, by the Longitudes and Latitudes of both places given, the Rumb and Distance may thus be found: Draw parallels by both Latitudes: take the distance of those parallels: according to which distance draw a parallel to the Equinoctial. Then from the end of the difference of Longitude, reckoned from the concurse of the Rumbs in the Equinoctial erect a perpendicular crossing the said Parallel: A line drawn by this crossing from the concurse of the Rumbs is the Rumb of the two places. Now to find out the Distance, take so many degrees of the Equinoctial

as

as the difference of Latitude conteineth: and guiding one foot of the Compasses in the Equinoctial, with the other foot carried parallel-wise at equall distance from the Equinoctial, crosse the Rumb newly found out: take the distance of this crossing from the concurse of the Rumbs, and set both feet of the Compasses in the Equinoctiall, for the degrees contained between them shew you the distance desired.

Secondly, by the distance and latitudes (knowing which place is more Eastwards, or Westwards) the Rumb and difference of Longitude is thus found: Take with the compasses so many degrees and minutes of the Equinoctial as the difference of Latitude conteineth: According to that distance draw a parallel to the Equinoctial; take so many degrees of the Equinoctial with your Compasses as the distance given commeth to: then one foot being set in the concurse of the Rumbs in the Equinoctial, with the other crosse the parallel aforesaid: A line drawn by that crossing from the concurse of the Rumbs in the Equinoctiall giveth you the Rumb desired. Then both Latitudes being noted in the graduated Meridian, therein take their difference with the Compasses, and guiding one foot in the Equinoctiall with the other carried at that distance parallel-wise from the Equinoctial crosse the Rumb of the two places, the distance of that crossing from the Meridian (that commeth from the common meeting of the Rumbs in the Equinoctial) taken with the Compasses, and brought to the Equinoctial, shall there shew you the difference of Longitude. Or a perpendicular to the Equinoctial from that crossing shall point you out therein, the difference of longitude.

2. By the distance and latitudes, to find the rumbe and difference of longitude.

Thirdly, by the Rumb and Latitudes (being both Northerly or both Southerly) the distance and difference of longitude is thus found: Take the difference of Latitudes in the Equinoctial: according to that distance draw a parallel to the Equinoctial (as before crossing the Rumb of the two places given: take the distance of this crossing from the concurse of the Rumbs: Then both feet of the compasses set in the Equinoctial will shew the distance of the places. The difference of Longitude is found as before.

3. By the Rumb and latitudes to find the distance and difference of longitude.

Fourthly, by the longitudes, Rumb and one Latitude (knowing whether it be the lesser or greater) to find the other Latitude, and the distance, doe thus: From the point of concurse of the Rumbs in the Equinoctial count the difference of longitude: from hence erect a perpendicular crossing the Rumb: the distance of this crossing from the Equinoctial translated into the graduated

4. By the longitudes, rumb, and one latitude, to find the other latitude and the distance.

duated Meridian (setting one foot in the known *Latitude*, and extending the other Northwards or Southwards according as the unknown *Latitude* is greater or lesser) shall shew you the *Latitude* desired. Now to find the distance, work as before in the first Probleme.

5 By the Rumb, the distance, and one Latitude, to find the other Latitude and the difference of Longitude

Fiftly, by the Rumb, distance and one *Latitude*, you may find the other *Latitude* and the difference of *Longitude* after this manner: Take the distance given with the Compasses in the Equinoctial: set one foot in the concurse of the Rumbs, and with the other crosse the Rumb given: from this crossing draw a perpendicular to the Equinoctial: the length of that perpendicular taken with the compasses and brought into the Equinoctial, shall shew you the difference of *Latitude*. Thus having both *Latitudes* given, the difference of longitude may also be found as before. *Prob.* 2.

Now in every one of these Problemes there may be some particular cases whereof some diversitie of working may arise, yet such as can breed but small trouble to him that well doth conceive the reason of that is already set down in these five former Problems: which are especialy to be applied to such places as are both on the same side of the Equinoctial, and differ also both in *Longitude* and *Latitude*: of which sort is the greatest number, and in which the greatest use, and most difficultie of working consisteth. To prosecute every particularitie at large (whereof some perhaps lesse acquainted with the reason of these Mathematical practises may be desirous) would be now for me too long and tedious. For some taste therefore of the use of this Nauticall Planisphere, let thus much for this time breefly suffice.

Chap. XIII

Error in the use of the Compasse, by the Variation neglected, and how to observe and avoid the same.

NExt the Sea-chart there is not any instrument of Navigation whereby greater error may ensue then by the Compasse, if the Variation be neglected. By which neglect alone we may often times misse an whole Point and more, in directing the Course from place to place. Notwithstanding, *M. Peter* of *Medina* laboureth greatly to prove that there is no Variation of the Compasse, and that many inconveniences and absurdities must needs follow out of that opinion (as

(as hee eſteemeth it) thinking it to have no better ground then the groſſe and erroneous obſervations of unſkilfull Mariners, as by the third Chapter of his ſixt booke of the Art of Navigation, may appear more at large. But daily experience (by many and diligent obſervations, with exact inſtruments, heedfully uſed by skilfull Obſervers, not only at ſea, the unconſtancie whereof (which cauſeth the ſhip to be alwaies unſteadie) might give ſome colour to *M. Peters* conceit of no Variation: but alſo on firm land, where moſt ſtedie and certain obſervation may eaſily be made:) I ſay daily experience hath ſo often, ſo conſtantly, ſo manifeſtly proved this varying propertie to be in the Compaſſe, that it cannot by any means with reaſon be denyed.

Now then for the better finding of this Variation there muſt be conceived two Meridians; a true Meridian, and a Magnetical Meridian: alſo a true Azimuth, and a Magnetical Azimuth of the Sun.

The true Meridian is an Azimuth paſſing by the Poles of the world.

The Magnetical Meridian is an Azimuth that paſſeth by the points of the wires in the Compaſſe, or of the Needle touched with the Loadſtone.

The true Azimuth of the Sun is ſhewed by the arch of the Horizon contained betwixt the Azmiuth of the Sun, and the true Meridian.

The Magnetical Azimuth of the Sun is ſhewed by the arch of the Horizon contained betwen the Magnetical Meridian and the Azimuth of the Sun.

The difference of theſe two arks of the Horizon is alwaies equal to the Variation of the Compaſſe.

To find out the Magnetical Azimuth of the Sun, we muſt firſt know upon what point of the Compaſſe the Sun is: which although it may be done by aim very neer the truth by him that is experienced, eſpecially when the Sun is low, or at the Horizon, riſing or ſetting: yet it may better be done with help of ſuch a ruler and ſights, as land-meaſurers uſe with their Plain Tables, wherewith you may thus find upon what point of the Compaſſe the Sun is: Lay the edge of the ruler right over the center of the Compaſſe: then holding the ruler ſo fixed, and the Compaſſe levell ſo neer as you can aim, turn it about untill the midſt of the Sun-beams paſſing through one of the ſights, fall alongſt upon the edge of the ruler, or midſt of the oppoſite ſight. Then holding your eye in ſuch ſort over the Compaſſe, that the rulers edge may

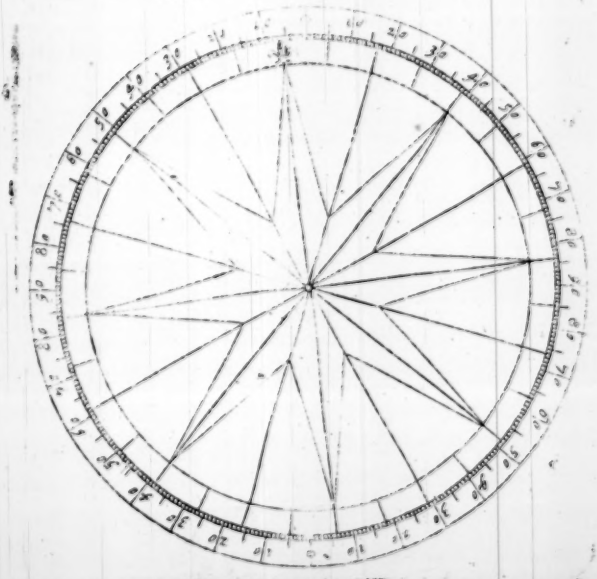
may lie right upon the center of the Flie, look also upon what point of the Compasse the edge of the ruler lieth to the Sun-wards for that is the point whereupon the Sun is at that time: which for brevities sake may be called the Suns point. This point you shall look in the instrument following, and it shall shew you amongst the degrees the Magnetical Azimuth of the Sun. As for example, when the Sun is due East by the Compasse, I would know in what Magnetical Azimuth he is: Therefore I look the East point in this Instrument, which directeth me to 84 degrees, which is the Magnetical Azimuth desired, And the difference betwixt this and the true Azimuth of the Sun is the Variation of the Compasse, which we seek for. This difference therefore shall thus be found out: At the same time when you observe the Suns point, let the height of the Sun be also observed. It is best to take both these observations about the midst of the forenoon, or afternoon, for then the height of the Sun altereth quickly, and the Refraction and Parallax cannot much deceive you; therefore at that time the true Azimuth of the Sun shall easily be known thus: First find out the Declination of the Sun, remembring alwaies to give allowance, or take away (according as the Declination increaseth or decreaseth) for the place and time of your Observation: Then set your Astrolabe to the Latitude of the place where you observe, and follow the Parallel of the Suns Declination, untill you come to the Almicantarath or height of the Sun known by observation: for the Azimuth that passeth by their mutual intersection is the true Azimuth of the Sun that was sought for: which if you follow down to the Horizon, you shall have that Azimuth given. Now of these two given Azimuths (that is the true and Magnetical Azimuth of the Sun) substract the lesser from the greater, for the difference remaining is the Variation of the Compasse: the denomination whereof (that is, whether it be Easterly or Westerly) shall easily be discerned thus: if the true Azimuth of the Sun counted from the South point in the forenoon, be lesse then the Magnetical Azimuth, the Variation is Easterly: otherwise it is Westerly. Contrariwise, in the afternoon: if the true Azimuth of the Sun be greater then the Magnetical Azimuth, the Variation of the Compasse from the point of true North is Eastwards, otherwise it is Westwards. And for the better understanding of these rules, I have in the Table following exemplified them by such Observations as I took both at Sea and Land, in the year 1589.

The instrument following is then to be used when Observation

on is made, as before hath bin ſhewed, by a Compaſſe, wherein the North points of the wires are ſet half a point to the Eaſtwards from the North point of the Compaſſe (of which ſort are the Compaſſes that are commonly uſed by Engliſh Mariners) whereas if the points of the wires were ſet juſt under the points of North and South: and the circumference of the Compaſſe divided into degrees both Eaſtwards and Weſtwards, beginning at the North and South points and ending with 90 at Eaſt and Weſt: we might at the firſt have the Magnetical Azimuth of the Sun by Obſervation, and ſo there ſhould be no need of this Inſtrument.

In the Table here following the letters N, W, S, E, b, in the firſt and ſecond columns, ſignifie North, Weſt, South, Eaſt, by. The fractions in the ſecond column are parts of the point whereto they are annexed. In the column intituled *The time of Obſervation*. the letters BN. and AN ſignifie, before noon and After noon.

An Inſtrument for the readie finding of the Suns Magnetical Azimuth by the ordinary Compaſſe.



The place of Observation.	The Suns point of the Compasse.	The hight of the sun		The Suns Magnetic. Azimuth.	
		Deg	Min	Deg	Min
About twenty leag. from Spain W	W N W ¾ N	0	0	69	30
30 or 40 leagues from Spain. W	E N E ½ E	0	0	56	15
About midway betwixt Lisbone	E N E	0	0	61	40
and Saint Michells.	W N W	0	0	73	7
Betwixt S. Michaels & Tercara.	E by N ¾ N	2	0	70	52
About 3. leag. from Tercara SSW	E by N ¼ N	2	30	70	53
At Saint Cruz in Flores.		29	25	83	30
		18	0	73	0
These Observations made in the		16	36	74	40
town of Fayal and the former		20	30	62	20
also at S. Cruz in Flores were		20	0	62	54
taken by M. William Borowes		19	20	63	35
Instrument of Variation (pub-		18	16	64	45
lished in his booke of the Varia-		30	41	57	15
tion of the Compasse) and by a		46	13	17	53
Quadrant, whose semidiameter		46	18	16	36
was almost three foot.		40	42	32	45
or 4 leagues from Tercæra S E	E S E ¼ E	0	0	75	50
From S. Maries W by S 6 leagues	W S W	13	0	61	50
From S. Maries W by S 6 leagues	W by S ½	0	0	67	25
From S. Maries South 5. leagues	E S E ½ S	0	0	69	30
From Saint Maries 16 leagues	E S E ¼ E	0	0	75	50
N W by W Northerly.	E S E	2	30	73	7 ½
From S. Georges S E by E 3 leag	E S E ¼ E	0	0	75	50
From the East part of S. Michael	W S W ¼ S	0	0	59	0
N E by N, about 15 or 20 leag.	E S E ¼ E	0	0	70	23
From the rock W about 66 leag.	S E by S ⅙ S	26		37	30
	E S E ½ S	0		67	30
From C. Finisterre N Eastерly	E S E ⅔ S	2		65	37
	S W	11		39	22

The Time of Observation.	The Latitude of the place of observation		The Declination of the Sun.		The true Azimuth of the Sun.		The Variation of the Compasse		The middle Variation.		The part of Variation
	De.	Mi	De.	Mi	De.	Mi	De.	Mi	De.	Min.	
Iul. 9 A N	39	50	20	53	62	0	7	30			Eastward
12 B N	39	0	20	25	63	20	6	45			Eastward
23 B N	38	0	17	55	67	0	5	20	5	38	Eastward
23 A N	38	0	17	46	67	10	5	57			Eastward
Aug 8 B N	38	20	13	13	74	10	3	18			Eastward
9 B N	38	20	12	54	75	0	4	7			Eastward
14 A N	39	50	11	5	79	30	4	0			westward
Se. 13 A N	38	54	0	8	74	35	1	35			Eastward
13 A N	38	54	0	9	76	0	1	20			Eastward
22 A N	38	54	3	39	67	10	4	50			Eastward
22 A N	38	54	3	39	67	30	4	36			Eastward
22 A N	38	54	3	30	68	15	4	40	3	5	Eastward
22 A N	38	54	3	40	69	20	4	35			Eastward
23 B N	38	54	3	53	54	20	2	55			Eastward
23 B N	38	54	3	54	14	0	3	53			Eastward
23 B N	38	54	3	54	13	30	3	6			Eastward
23 A N	38	54	4	0	35	15	2	30			Eastward
Oc. 18 B N	38	20	13	5	73	0	2	5			Eastward
23 A N	37	0	14	50	60	0	1	50	0	55	Westward
23 A N	37	0	14	51	71	5	3	40			Eastward
24 B N	37	0	15	2	70	50	3	20			Westward
26 B N	37	30	15	38	69	50	6	0	5	34	Eastward
26 B N	37	30	15	39	68	0	5	7			Eastward
28 B N	38	40	16	16	68	45	7	5			Eastward
No. 1 A N	38	40	17	30	67	10	8	10			Eastward
2 B N	38	40	17	41	66	50	3	33			Eastward
6 B N	38	35	18	43	31	0	6	30			Eastward
12 B N	44	25	20	5	61	0	6	30	7	4	Eastward
12 B N	44	25	20	5	58	0	7	37			Eastward
12 A N	44	30	20	11	46	15	6	52			Eastward

Notwithstanding there be much difference betwixt some of these Variations taken at the same place with the same Instruments, yet we used with what diligence we could such Instruments as then we had prepared for that purpose: which I speak, that others that shall go about hereafter to observe the Variation (at Sea especially) may be the more circumspect to foresee and prevent all causes of error herein. Exact truth amongst the unconstant waves of the Sea is not to be looked for, though good Instruments be never so well applied to their use. Yet with heedfull diligence we may come so neer the truth, as the nature of the Sea and of our sight and Instruments will give us leave. Neither if there be some disagreement betwixt Observations, are they all by and by to be rejected. But as when many arrows are shot at a mark, and the mark afterwards taken away, he may be thought to work according to reason, who to find the place where the mark stood, shall seek out the middle place amongst all the arrows: so amongst many different Observations, the middlemost is likest to come neerest the Truth.

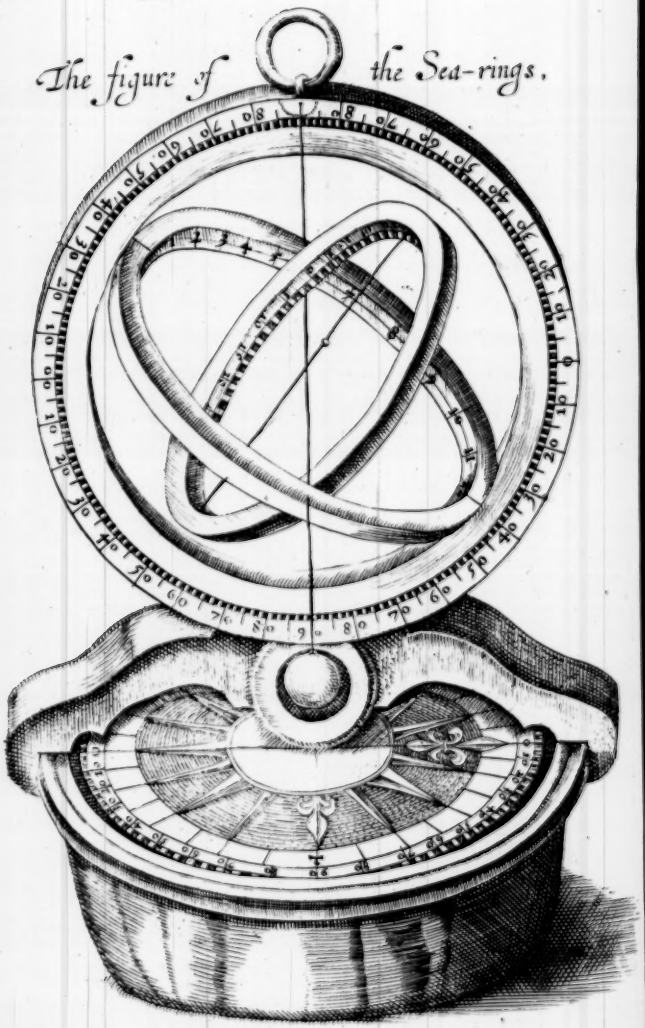
Causes of error herein: Some cannot be avoided, as the unsteadinesse of the Ship, the imperfection of the sence and Instruments, the weak respective force of the needle or wires, be they never so well touched. Others may be eschued, as that there be no iron neer the Compasse in the time of Observation, that the wires be kept clean from rust, and that they be not kept too long untouched from the stone, that such Instruments be used for Observation as need least working afterwards for finding out the Variation: wherein the Instruments heretofore published for this purpose, are faultie; being such as serve for Observation onely on Land: as also requiring many workings afterwards, unfit for Mariners before the matter can come to issue, wherein are as many lurking holes of error, without great diligence. I have therefore here set down the making and use of a certain Instrument, whereby the Variation of the Compasse and time of the day is presently given, together with the Observation (the Latitude of the place being known) and that universally throughout the World, both at Sea and Land. As also the Variation being given, the height of the Pole, and hour of the day may thereby be known, without those inconveniences, wherewith *Martin Curtis* his instrument, Chap. 11. part 3. of the Art of Navigation, and *Michael Coignet* his Nautical Hemisphere, are much incumbred: to omit the Observation of the height of the Sun, which (as I have oft made tryal at Sea) may thereby be more exactly perfor-

performed, then hath been hitherto by Staffe, Ring, or Aſtrolabe, as they are commonly uſed.

The making of the Sea-Rings.

MAke four Rings of equal thickneſs and breadth covenient, ſo as they may not eaſily bend: let them be fitted that each of them may go cloſe within other. The two greateſt of theſe Rings muſt be ſo made and framed together, that the innermoſt may ſlide about within the outermoſt, both ſides agreeing alwaies, even together in one and the ſame plain ſuperficies. Within the innermoſt of theſe two Rings muſt the third ring be hanged upon two round pins diametrally oppoſite each to other; ſo as upon them it may be turned aſide, till it make right angles with the former. Again, within this third ring muſt the fourth be hanged likewiſe upon two pins diametrally oppoſite, 90 deg. diſtant from the former pins. The uppermoſt Ring repreſenteth the Meridian fixed: the next within it repreſenteth a Meridian moveable: the third ſignifieth the Equinoctial or parallel of the Sun: the fourth, the circle paſſing by the points of Eaſt and Weſt, and by the poles of the world. Upon one of the ſides of the innermoſt and moveable Meridian (90 degrees from the pins whereupon the Equinoctiall Ring hangeth) muſt be fixed an Index or pointer, the point whereof may reach unto the midſt of the convexitie of the innermoſt circle, into a little hole, diſtant from the middle point between the pins or poles whereupon it hangeth ſo much as half the thickneſs of that circle commeth to, as the point of that Index being put into this hole, the Meridian and the inner circles may croſſe each other preciſely at right angles. Ninetie degrees from the pins or poles of this innermoſt Ring, through the midſt of the concavitie and convexitie thereof, muſt two ſmall holes be made; and a thred ſtretched ſtraight betwixt them (repreſenting the axeltree of the World) with a ſmall bead (about the bigneſſe of a pins head) put hereupon, repreſenting the center of the earth. Let the upper half of the uppermoſt and fixed Meridian be divided into 180 degrees, ſetting figures to every tenth or fifth degree, beginning at either end, and ending in the midſt with 90, which repreſenteth the Zenith: where a Ring muſt be ſet thereto, to hang the whole inſtrument by, as the manner is in the uſe of the Aſtrolabe. Diametrally oppoſite to the midſt of this ſemicircle, there muſt be faſtned to the convexitie of this fixed Meridian the foot-piece of this Inſtrument, made of ſome ſuch

The figure of the Sea-rings.

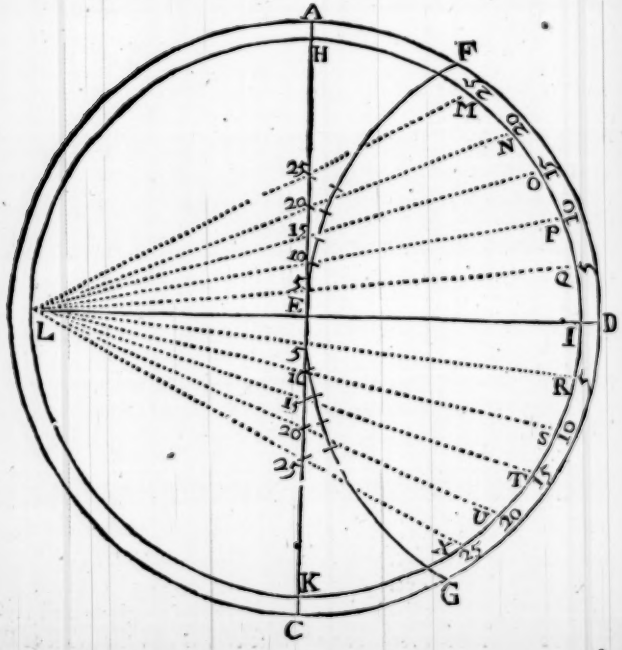


faſhion and proportion as here you ſee, agreeing in one and the ſame plain ſuperficies with the Meridian, and the line paſſing by the feet thereof making right angles with the Zenith line. To the feet of this peece muſt be annexed the *Sea Compaſſe*, in ſuch ſort that the Zenith line of the graduated ſide of the Meridian may fall perpendicularly upon the center thereof the plain ſuperficies of the Meridian making right angles with the plain of the Compaſſe. All theſe circles, and Compaſſe being thus joyned together, the whole Inſtrument muſt be rectified and equally counterpoized by the help of a plumb-line hanging on a ſmal pin at the Zenith point directly under the Ring, that hanging the Inſtrument by the Ring (like an Aſtrolabe) the plumb-line may fall preciſely upon the Nadir point of the fixed Meridian, ſcarcely touching the ſame: for ſo the Inſtruments own weight, hanging it onely by the Ring (like an Aſtrolabe) ſhall make it hang exactly perpendicular, when ſoever you uſe it. Let the points of the wires in the Compaſſe be placed juſt upon the points of North and South in the Flie; the circumference whereof muſt be divided into degrees, beginning at thoſe points, and from thence proceeding both waies, ſet figures at every fifth or tenth degree, ending with 90 at the points of Eaſt and Weſt. Through the midſt of the concave ſide of the third Ring (repreſenting the Equinoctial) muſt a periphery be drawn round about, which may be called the parallel of the Sun. It ſhall be good alſo (though not needfull for finding the Variation) to divide it into 24 equal parts or hours, and quarters, or ſmaller parts, for knowing the time of the day.

Vpon the concave ſide of the innermoſt Ring let be deſcribed the degrees of the Suns declination, for the right placing of the little bead upon the thred according to the time of the yeer. Which may eaſilieſt be done after this manner.

Draw upon a paſtbord the peripherie A B C D equal to the foreſaid parallel of the Sun drawn through the midſt of the concavitie of the Equinoctial Ring: croſſe this peripherie at right angles with the diameters A C, B D at the center E. Then take with your compaſſes the ſemidiameter E D, and ſetting one foot in the end of the diameter D, with the other draw the arch G E F; in which arch prick out both waies from E ſo many degrees, as the Suns greateſt declination amounteth unto: and laying your ruler to D, and to every one of thoſe degrees; croſſe the diameter A C with ſhort ſtrokes, as you ſee in this diagram, and laying the ruler to every one of thoſe croſſes and the prick at B,

make pricks by the ſide of the ruler in the innermoſt peripherie H I K L, which muſt be equal to the concavitie of the innermoſt Ring of the Inſtrument: And then laying the concavitie and quarters of that Ring juſtly agreeable with this peripherie, and the ends of the diameters thereof (the thred upon which the little bead rideth) lying right over the diameter H K, you may with a ſharp point of ſteel ſtrike up the ſaid pricks made in the innermoſt peripherie into the concavitie of the innermoſt Ring, and to every fifth or tenth degree ſet figures, as the manner is. There muſt alſo be made in the ſaid innermoſt Ring a point anſwerable to the point at B in this former figure, in which point there muſt be faſtned a ſmall ſtump, ſtanding upright, from the ſide of that Ring about the height of a pins head. By means whereof and the degrees of the Suns declination (projected, as we have ſhewed, into the concavitie of the innermoſt Ring) the little bead muſt be right placed upon the thred, by bringing it into a ſtraight line between tht ſtump and the Suns declination anſwerable to



the

the time of your Obſervation: which may be done by laying the edge of a ſtraight ruler, or a ſmall thred ſtretched from that ſtump, to the degree and part of the Suns declination, and then bringing the midſt of the bead under that edge or thred: Or elſe by ſight only, with one of your eyes, laying the top of that ſtump upon the Suns declination, and then bringing the bead between; ſo as you may ſee them all three in one ſtraight line.

The bead being thus rightly placed, put aſide the Equinoctial Ring from the braſſe pointer (repreſenting the Pole Actick) that it may croſſe the meridian at right angles, which it ſhall preciſely do, if you bring the prick or little hole, upon the out-ſide of the innermoſt circle to the end of the foreſaid braſſe pointer, ſo as the end thereof may enter thereinto. Then ſet the line that is drawn from the end of the braſſe pointer, to the elevation of the Pole at the place of your Obſervation, and ſo have you all parts of your Inſtrument rightly placed for Obſervation.

The uſe of this Inſtrument.

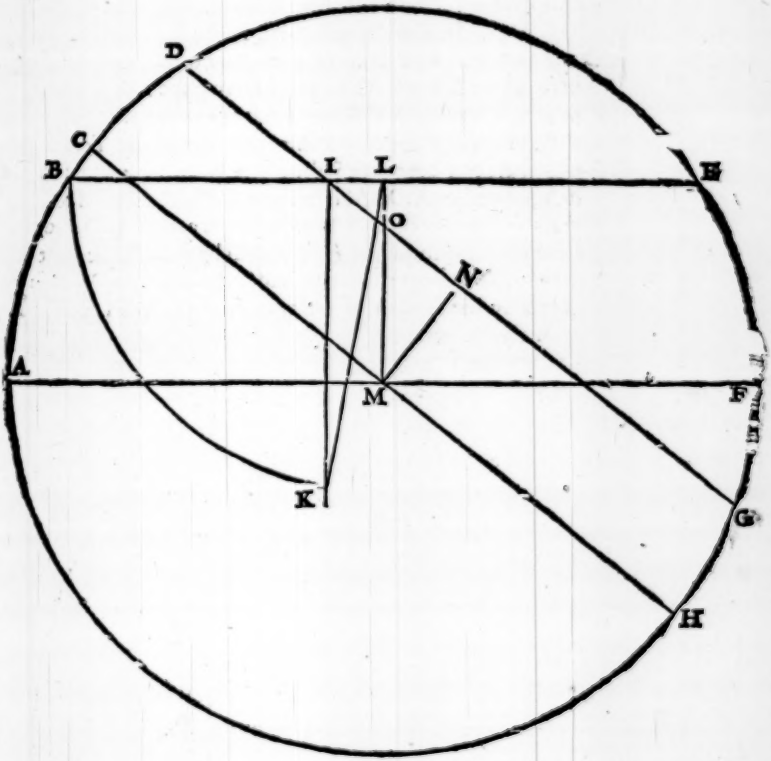
Now when you will make Obſervation with this Inſtrument, hang the ſame by this Ring upon your finger, as you do when you Obſerve the height of the Sun with the Aſtrolabe, turning the foreſaid braſſe pointer Northwards, till you find the midſt of the ſhadow of the bead to fall upon the peripherie, drawn round about through the midſt of the concavitie of the Equinoctial ring, which peripherie we called the parallel of the Sun: and ſo keep the whole Inſtrument and Compaſſe as ſteady as you can, till the flie of the Compaſſe remain quiet and ſtill; keeping in the mean time the midſt of the ſhadow of the bead alwaies upon the foreſaid parallel of the Sun; and withall looking cloſe by the graduated ſide of the Meridian, directly down upon the midſt of the Compaſſe; and mark what degree and minute you ſee cloſe thereby in the North part of the Flie: for ſo much as the North point of the needle or wiers is from thence towards the Eaſt or Weſt, ſo much is the Variation Eaſtwards or Weſtwards. And the ſhadow of the bead lighting upon the Parallel of the Sun ſheweth the hour and time of the day.

The beſt time for the taking of theſe Obſervations is about the midſt of the forenoon or afternoon, becauſe that about thoſe times the height of the Sun altereth quickly, and his Refraction alſo can breed no ſenſible error. But becauſe there be many that want both this Inſtrument, and alſo the Globe and Aſtrolabe before-mentioned, I have for their ſakes thought it good to ſet down a way whereby (the Declination and height of the Sun being given, together with the Latitude of the place) the Suns true

true Azimuth may be found with Ruler and Compaſſes onely, after this manner: Draw the circle A B C D E F G H, repreſenting the Meridian, by the center hereof draw the diameter, of the Horizon A F. From A the end of this diameter, reckon the elevation of the Equinoctial A C; from whence draw a line by the center (which may be called the diameter of the Equinoctial) A C; from C the end of this diameter count the declination of the Sun C D: thereby draw a Parallel to the diameter of the Equinoctial, which may be called the diameter of the Suns Parallel D G: Likewiſe from the diameter of the Horizon count the height of the Sun A B, known by Obſervation, and thereby alſo draw B E a Parallel to the diameter of the Horizon, which may be called the diameter of the Suns Almicantar. From I, the interſection of theſe two Parallels, draw I K, a line perpendicular to the diameter of the Horizon. Then ſetting one foot of the Compaſſes in L, the midſt of B E the diameter of the Suns Almicantar, and ſtretching out the other foot to B the end of this diameter: from thence draw therewith the arch B K till you come to the ſaid perpendicular: This arch reſolved into degrees ſhall give you the true Azimuth of the Sun.

Now

Now (for them that liſt) by the doctrine of Triangles alſo, M N (the ſine of the Suns Declination) being given, with the angle M O N (equal to the height of the Pole) in the right angled Triangle, O N M: the ſide O M ſhall likewiſe be given:



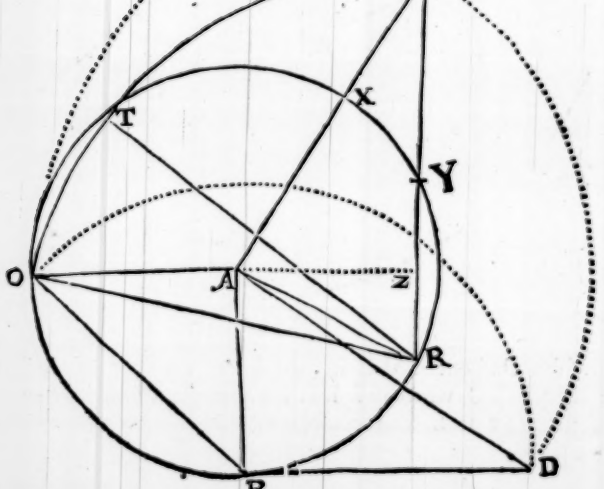
which ſubtracted out of M O L (the ſine of the Suns height) there remains L O, whereby L I, in the Triangle L I O, having one right angle at L, and conſequently I L K the angle deſired, are given.

CHAP.

CHAP. XIIII.

To find the Inclination or dipping of the Magnetical needle under the Horizon.

LEt O B R be a Meridian of the Earth, wherein let O be the Pole, B the Equinoctial, R the Latitude (ſuppoſe 60 degrees) let B D be perpendicular to A B in B, and equal to the ſubtenſe O B; and drawing the line A D, deſcribe therewith the arch D S V. Then draw the ſubtenſe O R, wherewith (taking R for the center) draw the arch O S. To the meeting of theſe two arches at S draw the lines R S equal to R O, and A S equal to A D. Alſo becauſe B R is aſſumed to be 60 degrees therefore let S T be $\frac{60}{90}$ parts of the arch S T O, and draw the line R T, for the angle A R T ſhall be the complement of the Magnetical Needles Inclination under the Horizon. Which may be found by the ſolution of the two Triangles O A R and R A S, after this manner:



First

Firſt the angle O A R is given becauſe of the arch O B R, meaſuring the ſame 150 degrees and conſequently the angle at R. 15 degrees being equal to the equal ſided angle at O; both which together are 30 degrees becauſe they are the complement of the angle O A R (150 degrees) to a ſemicircle or 180 degrees.

Secondly, in the Triangle A R S all the ſides are given, A R the Radius or ſemidiameter 10,000,000: R S equal to R O the ſubtenſe of 150 degrees 19,318,516: and A S equal to A D triple in power to A B, becauſe it is equal in power to A B and B D, that is B O; which is double in power to A B. Or elſe thus: The arch O B being 90 degrees, the ſubtenſe therof O B, that is, the Tangent B D is 14,142,126, which ſought in the Table of Tangents, ſhall give you the angle B A D 54 degrees 44 minutes 8 ſeconds: the Secant whereof is the line A D that is A S 17,320,508. Now then by 4 Axiom of the 2 book of *Priſc.* As the baſe or greateſt ſide S R 19,318,516 is to the ſum of the other two ſides S A and A R 27,320,508; ſo is the difference of them S X 7,320,508 to the ſegment of the greateſt ſide S Y 10,352,762; which being taken out of S R 19,318,516, there remaineth Y R 8,965,754, the half whereof R Z 4,482,877, is the ſine of the angle R A Z 26 degrees 38 minutes 2 ſeconds, the complement whereof 63 degrees 21 minutes 58 ſeconds is the angle A R Z, which added to the angle A R O 15 degrees maketh the whole angle O R S, 78 degrees 21 minutes 58 ſeconds; whereof $\frac{60}{90}$ make 52 degrees 14 minutes 38 ſeconds which taken out of A R Z 63 degrees 21 minutes 58 ſeconds there remaineth the angle T R A 11 degrees 7 minutes 20 ſeconds the complement whereof is the Inclination ſought for, 78 degrees, 52 minutes, 40 ſeconds.

A ſhorter way to calculate the Table of Magnetical Inclination.

The ſum and difference of the ſides S A and A R being alwaies the ſame, *viz.* 27,320,508 and 7,320,508, the product of them ſhall likewiſe be alwaies the ſame, *viz.* 199,999,997,378.064 to be divided by the ſide S R that is R O the ſubtenſe of R B O. Therefore there may be ſome labour ſaved in making the Table of Magnetical Inclination, if in ſtead of the ſaid product you take continually but the half thereof that is 99,999,998,689,032, and ſo divide it by half the ſubtenſe R O, that is, by the ſine of half the arch O B R. Or rather thus: As half the baſe R S (that is, as the ſine of half the arch O B R) is to half the ſum of the other two ſides S A and A R 13,660,254, ſo is half the difference of them 3,660,254 to half of the ſegment S Y, which taken out of half the baſe, there remaineth R Z the ſine of R A Z,

First col. Height of the Pole	Second col. Magnetical Inclination.		First col. Height of the Pole.	Second col Magnetical Inclination.		First col. Height of the Pole.	Second col. Magnctical Inclination	
Degrees	Degr.	Min.	Degrees	Degr.	Min	Degrees	Degr.	Min.
1	2	11	31	52	27	61	79	29
2	4	20	32	53	41	62	80	4
3	6	27	33	54	53	63	80	38
4	8	31	34	56	4	64	81	11
5	10	34	35	57	13	65	81	43
6	12	34	36	58	21	66	82	13
7	14	32	37	59	28	67	82	43
8	16	28	38	60	33	68	83	12
9	18	22	39	61	37	69	83	40
10	20	14	40	62	39	70	84	7
11	22	4	41	63	40	71	84	32
12	24	52	42	64	39	72	84	57
13	25	38	43	65	38	73	85	21
14	27	22	44	66	35	74	85	44
15	29	4	45	67	30	75	86	7
16	30	45	46	68	24	76	86	28
17	32	24	47	69	17	77	86	48
18	34	0	48	70	9	78	87	8
19	35	36	49	70	59	79	87	26
20	37	9	50	71	48	80	87	44
21	38	41	51	72	36	81	88	1
22	40	11	52	73	23	82	88	17
23	41	39	53	74	8	83	88	33
24	43	6	54	74	52	84	88	47
25	44	30	55	75	35	85	89	1
26	45	54	56	76	17	86	89	14
27	47	15	57	76	57	87	89	27
28	48	36	58	77	37	88	89	39
29	49	54	59	78	15	89	89	50
30	51	11	60	78	53	90	90	0

whose

whoſe complement to a quadrant is the angle ſought for A R Z.

According to this Diagram and demonſtration, was calculated the Table here following; the firſt column whereof containeth the height of the Pole for every whole degree; the ſecond column ſheweth the Inclination or Dipping of the Magnetical Needle anſwerable thereto in degrees and minutes.

CHAP. XV.

Error in uſing the Croſſe-ſtaffe, and how they may be avoided.

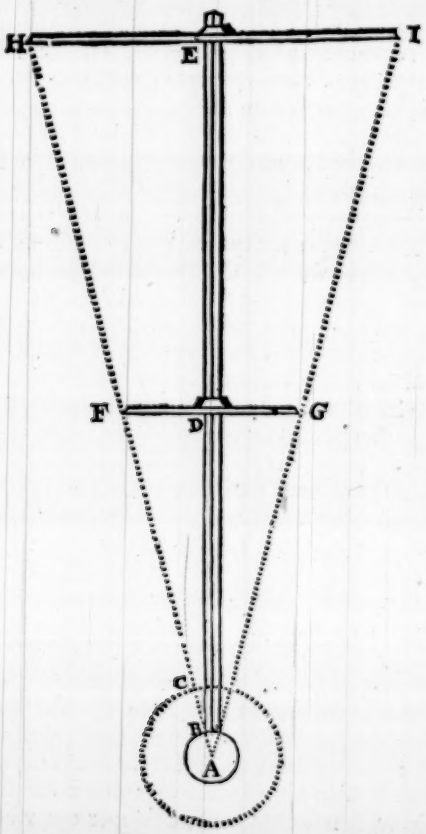
AFter the Chart and Compaſſe, the Croſſe-ſtaffe may with good reaſon ſucceed, as in the uſe whereof more error is committed, then in any other Inſtrument of Navigation, the two former excepted; and that four ſeverall waies: Firſt in neglecting the Paralax or Eccentricitie of the eye. Secondly, in not conſidering the height of the eye above the Water: Thirdly and Fourthly, in not regarding the Paralax and Refraction of the Sun.

For the firſt, they count the height of the Sun and Stars in ſuch ſort as if the center of the eye, or vertex of the viſual cone in uſing the Staffe, were even with the end thereof, that is ſet to the eye. Therefore how much the center of the ſight is diſtant from the end of the Staffe, ſo much are they deceived. But how much the Eccentricitie or Paralax of the eye is, it may be known after this manner: Make two Tranſverſaries, the one twice ſo long as the other. The longeſt of theſe two ſet faſt at the further end of the Index, the other of them move up or down upon the Index, untill ſuch time that your eye placed at the end of the Index (in ſuch ſort as you uſe to place it when you obſerve) you may ſee both ends of both Tranſverſaries lie even together. For then look how much the ſegment of the Index betwixt the two Tranſverſaries exceedeth the ſegment from the ſhorter Tranſverſarie unto the eye, ſo much is the Parallax or Eccentricitie of your ſight, or the point wherein your eye, wherein the viſual beams concur, is ſo much diſtant from the end of the Index.

As for example, in this figure let the Tranſverſarie H E I placed at E the end of the Index be double to the Tranſverſarie F D G, which is placed in ſuch ſort upon the Index, that the viſual lines (A F H, A G I) of the eye placed at the end of the Index do paſſe ſtraight on by F H and G I, the ends of the Tranſverſaries. For in this figure, A is the center of the ſight or eye, wherein the

viſual lines (A F H, A G I) doe concurre. B repreſenteth the end of the Index, placed at the corner of the eye, and then A B is the Eccentricitie: C ſignifieth the end of the Index ſet againſt the bone underneath the eye, for obſerving of diſtances, and then A C is the Eccentricitie, which is thus demonſtrated:

As H E is to F D, ſo E D A to D A, 13.*e* 5.*Ra.* But H E is double to F D by ſuppoſition: therefore E D A is double to D A, and D A the half of E D A equal to the other half D E. Therefore how much B D or C D is ſhorter then D E, ſo much is the Paralax or Eccentricitie of the eye, and ſo much muſt the Tranſverſarie be removed forwards (from the place where he was ſet



in

in the time of your Observation) towards the farr end of the Index, after you have observed any height or distance of the Sun or Stars, that so you may have the true height or distance desired. Or else you may have a plate of brasse, so Artificially fitted close within, by the side of the square hole in the Transversarie, through which the Index is to be put, that you may slip it forwards or backwards like the cover of a Box, and so set the fore-edge thereof so much before the Transversarie, as the Eccentricitie of your eye commeth to (having first turned the flat and straight side of the Transversarie from you-ward, and pared the ends thereof, in such sort that the visual beams may touch the extreames of that side) that so the edge of the plate may at the first shew upon the Index the true height or distance of the Sun or Stars observed without any further correction. Otherwise if this Paralax of the sight bee neglected, there may be error of an whole degree and more sometimes, in observing with those small Crosse-staves which have been commonly used.

Secondly, they increase the former error by not regarding the height of the eye above the Water. Which although it be not so great a fault as the other, yet it may deceive them by increasing the former error, five or six minutes or more in a tall Ship. For the higher the eye is above the water, the greater is the angle contained betwixt the two visual lines, whereof one toucheth the convex superficies of the Sea, the other passeth on to the Sun or Stars: And the lower the eye is, the lesse is the foresaid angle: and then onely it sheweth the true Altitude, when the center of the sight is in the same line of levell with the superficies of the Water. But if the eye be higher then the Water, that angle is greater then the true Altitude, and therefore subtraction must be made accordingly, that you may have the true Altitude.

Now to find how much it is that should be subtracted at any height of the eye above the Water there be two waies; the one without knowledge of the Earths semidiameter, the other with knowledge of the same. For the first, you must have some such convenient place at the Water side where you may have a free and cleere prospect unto the Sea without impediment, and where you may also have such provision made, that you may place both your self, and also an exact and large Water Levell in convenient manner to make exact observation at what height soever you desire above the superficies of the Sea, till you come to the height of the tallest Ships that go upon the Seas: that levell having the sight that you must look through at the end thereof

next the eye ſo fitted, that you may both eaſily and ſteadily ſet it higher then the fore ſight (that is the ſight that is at the fore-end of the Levell) ſo much as ſhall be needfull to lay the fore-ſight preciſely to the touching of the Sea; and that you may alſo perfectly know how much the back-ſight, or ſight at your eye, is higher then the fore-ſight above the line of Levell: For by the difference of the heights of thoſe ſights above the line of Levell, and the diſtance between them, it may eaſily be found how much the viſual line touching the roundnes of the Sea, Dippeth under the line of levell, or true Horizon, from whence the height of the Sun and Stars is to be accounted, thus: As the diſtance betwixt the ſights is to the difference of their heights above the line of levell; ſo is the whole ſine to the Tangent of the angle of Dipping, which we deſired to know.

This angle may otherwiſe be found, the quantitie of the Earths ſemidiameter being firſt known, which is to be done divers waies; but they may be all reduced to two heads or kinds, whereof the firſt requireth the certain meaſure of ſome arch of the Meridian to be firſt given, which is alſo divers waies to be performed. But the beſt and perfectest way of all others is to obſerve ſo exactly as is poſſible the Summer ſolſtitiall Altitude of the Sun at two places, ſo farr diſtant aſunder, and lying ſo neer North and South each from other with ſo direct and faire a way betweene them as conveniently may be choſen. Suppoſe for example *Portſmouth* and *Barwick*, or ſome other place in the furtheſt parts of *Scotland*; for the further theſe places are each from other, the more perfectly may this buſineſſe be performed. Then meaſure, and plat down ſo truly as is poſſible all the way betweene thoſe two places, with all the turnings and windings, aſcents and deſcents that are therein; out of which the arch of the great circle, or ſhorteſt diſtance betwixt them, together with the angle of declination thereof from the true Meridian line truly found by obſervation at either of thoſe places, may moſt exactly be knowne: whereby (with helpe of the doctrine of right angled ſphæricall triangles) the difference of the latitudes of thoſe two places in miles and forlongs &c. may eaſily appeare; which compared with the difference of the latitudes of the ſame places, found by obſervation of the Sun in degrees and minutes, &c. will ſhew how many miles and furlongs anſwer to one, or more degrees of the meridian: and ſo the whole circumference, diameter, and ſemidiameter of the earth will eaſily, and more truly be found, then any other way yet uſed for this purpoſe. But meanes

A moſt exact way to find the quantitie of the Earths ſemidiameter

conve-

convenient for the triall hereof have hitherto been wanting, and ſo I muſt omit it, till ſome better opportunity, if any ſhall befall hereafter, by the bounty of any ſuch as are of more ability to bear the charge hereof. Yet beſides our purpoſe now in hand, this would bee the beſt ground that can be both for the making and continuing of a Standard, and all other meaſures thereon depending, at a certainty for ever; inſomuch that although all the Standards, weights and meaſures in the world were loſt, they might notwithſtanding upon record of ſuch Obſervation and means as here we have mentioned, be again reſtored much more perfectly then by the ordinary way of beginning all our meaſures from a barly grain taken out of the midſt of the Ear, whereof there is no ſuch certain determinate bigneſs that can be ſet down, but that they may be ſomething greater in one Ear then another; neither can there be any certain rule or reaſon given how to know which Ear to chuſe rather then other, for this purpoſe. And if any error be committed herein, though inſenſible (which cannot be avoided) yet in going about to make other greater meaſures by often taking this leaſt, and ſo proceeding *à minimis ad maxima*, ſo often as you take your firſt or leaſt meaſure, ſo often doe you increaſe and multiply your error: which though at the firſt it ſeem very ſmal and ſcarcely perceivable, yet commeth at the laſt to be very notorious and intollerable. But the other way I here ſpeak of taking the length of all *England*, or of the whole Iland, for our firſt meaſure, and cut of it by ſubdiviſion dividing all the reſt, although wee may erre ſomething in taking the length hereof (which notwithſtanding, I dare undertake may be ſo handled, that it ſhall not be ſo much as the thouſand part of the whole diſtance between the two places, before mentioned) yet becauſe we proceed *à maximis ad minima*, ſo ſtill dividing, and the more diminiſhing this error, the further we proceed; it will in the end, when we come to our ordinary meaſures moſt in uſe, become very inſenſible and not worth the regarding

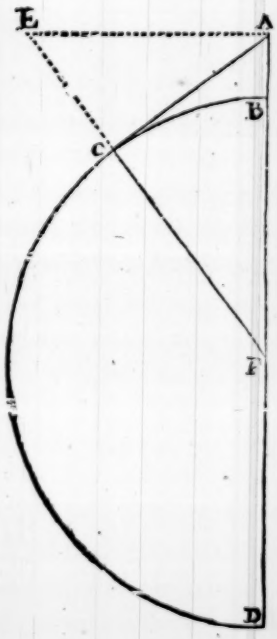
But to return to our purpoſe from whence we have a little digreſſed: The Earths ſemidiameter may in like manner be found by Obſervation of the Meridian Altitudes of any notable fixed Star at the two places before mentioned: but becauſe the heights of Stars cannot by any means be ſo exactly obſerved as the height of the Sun may be; the difference of the Latitudes of the two places, and conſequently the Perimeter (that is the Circuite or Compaſſe) and the diameter of the Earth cannot be ſo perfectly found by this way as by the former.

As for that way which findeth the height of the Sun and ſo the Latitudes, by the length of the ſhadow of a ſtile or Gnomon perperdicularly erected, it is like to be more uncertain then either of the former, by reaſon of the ſcattering and uncertain determining of the end of the ſhadow; beſide the knowledge of the Suns ſemidiameter hereunto required, which inconveniences may in the former waies be avoided.

The quantity of the Earths diameter is alſo to be found more eaſily, though not ſo exactly (without obſerving any height of Sun or Star, or meaſuring any arch of the Meridian) by means of ſome great height given neer the Sea ſide; as namely the height of ſome high mountain, from whoſe top you may have a free proſpect ſo farr as you can ſee upon the Sea. Which *Maurolycus* endevoureth to do after this manner.

Clau. Comm. in 1 Cap. Ioan. de Sacroboſc.

Let B C D be the Circuit of the Earth A B the height of ſome hig mountain to be found by the rules of meaſuring heights (But here hee ſhould have done well to have ſhewed us by what rules; for the ordinary rules will not ſerve the turne) A C a viſual line from the top of the mountain to C the point of the touching thereof with the Sea or plain Land where no hils are; (but ſuch Land wil very hardly be found that may ſerve for this purpoſe) C B the diſtance (without ſenſible error) of that point of touching from the perpendicular ſhewing the height of the mountain; to be found alſo by the rules of meaſuring lengths ſo farr as we can ſee from the top of the mountain A. (But here alſo he ſhould have ſhewed ſome certain rule how to find both the point of touching C, and alſo the diſtance to it from B and not ſo groſſely to ſlubber over ſo nice a point as this is, in bidding us meaſure ſo farr as we can ſee) Then rudely taking



Maurolycus & *Cladius* his groſſe demonſtration.

taking A B C for a plain right angled Triangle with the ſides A B and B C found as before, we may without any further rubbe, proceed, and find both the *Hypotenuſa* or Tangent A C by the 47.1 *Encl.* As alſo the Earths diameter B D by the 37.3 *Encl.* Yet here I cannot but marvell that ſo great a Clerk as *Clavius* ſhould ſo ſleightly paſſe over ſuch groſſe abſurdities as theſe, without any touch or warning at all given to his Readers, that they might not be abuſed by them; much leſſe correcting them, or ſhewing any better meanes how to reſolve this probleme; which may notwithſtanding much more eaſily and geometrically be done by finding the height of the mountaine with an exact water levell, beginning at the ſuperficies of the Sea water, in ſome Creek where it reſteth ſmooth and clame; and from thence proceeding till you come to the top of the mountain, alwaies placing the levell (ſo neere as may be) in the middle between the back-marke and fore-marke, which are uſed in levelling and ſo adding all your aſcents together, you ſhall have very exactly the true height of the mountain above the roundneſſe of the Sea. Then having the ſights fitted in ſuch ſort, as before we have ſhewed, that you may raiſe the back-ſight (or ſight at your eye) higher then the fore-ſight (at the farr end of the Levell) ſo much as ſhall be needfull; place the Levell, ſo truly and ſteadily as you can, upon the top of the mountain; and ſo diſpoſe the ſight at your eye, that you may ſee the fore ſight lie even with the touching of the Sea, whereby the angle of depreſſion or Dipping of the viſuall line under the line of Level may be found by the difference of the heights of the ſights, as before is ſhewed. And then as the exceſſe of the Secant of that angle above the whole Sine is to the whole Sine: ſo is the height of the mountain A B (already found) to the ſemidiameter of the Earth, B F. For F C being continued to E and A E repreſenting the line of Levell or true Horizon; E A C the angle of dipping ſhall be equal to the angle A E C (by 16.3 and 8.6 *Encl*) the Secant whereof is A F; the whole Sine B F (proportional to the Earths ſemidiameter) and the difference of them A B, proportional to the height of the mountain.

But having not hitherto had means requiſite to make triall of any of theſe waies already mentioned, I have thought of another way, whereby the height of the mountain, and conſequently the quantity of the Earths ſemidiameter may be known; wherein becauſe there is great variety of Opinions amongſt the Ancient and later Writers, ſome making it to be almoſt 8000 miles; ſome little more then 5500, ſome others not much exceeding

5000; others making it leſſe then 3600; and others not much more then 3200, as *Alphraganus*, though *Fernelius*, according to his Obſervation, findes it to be 3900 miles, whereas others of late will have it little more then 3000: therefore in ſo great diverſity and uncertainty of opinions, I took it to be the beſt courſe, both for mine own and others ſatisfaction, to reſt my ſelf upon ſuch grounds as I could find by mine own experience and obſervation, and that after this manner:

Firſt, I made for this purpoſe an Inſtrument in forme of a right angled Triangle, whoſe ſides containing the right angle were about ſix foot long; one of which ſides was divided into 10,000 equal parts, whereby the degrees and minutes anſwerable to them were eaſily to be found out of the Table of Tangents. This Inſtrument thus prepared and placed ſtadings upon his Baſes, about three foot above ground, on a hill neer *Plimmouth ſound*, I directed one ſide thereof about the right angle, as exactly as I could, to the midſt of a ſmall Rock, appearing a little above the Sea water, neer the great Rock called the *Meuſtone*, lying at the entrance of *Plimouth ſound*: Then, as the other ſide of the Inſtrument about the right angle directed me, I took my ſecond ſtanding 664 foot by juſt meaſure from the firſt: which diſtance was ſo much as the ground would well give me leave to take, for otherwiſe I would have gone further. At this ſecond ſtation I found the angle contained between the viſuall lines directed to the firſt ſtation and that ſmall Rock to be 87 degrees, 52 minutes; the Tangent whereof is 26,845 ſuch parts whereof the diſtance of the ſtanding or whole ſine containeth 1000: whereby the diſtance from the firſt ſtation to the ſaid ſmall Rock was found to be 17,825 foot: for as 1000 to 26,845; ſo are 664 foot to 17,825 foot.

Then comming again to the firſt ſtation, and ſetting the Inſtrument ſteady up on edge I firſt directed one of the ſides about the right angle (lying neer the ground) to the ſaid little Rock, and then a Plumbline hanging at the upper corner of this Triangular Inſtrument did fall 1 degree 14 minutes from the right angle forwards. After this I directed the ſame ſide, as truly as I could, to the very touching of the Sphæricall ſuperficies of the Sea; and then the Plumbline fell 22 minutes from the ſame right angle forwards towards the Sea.

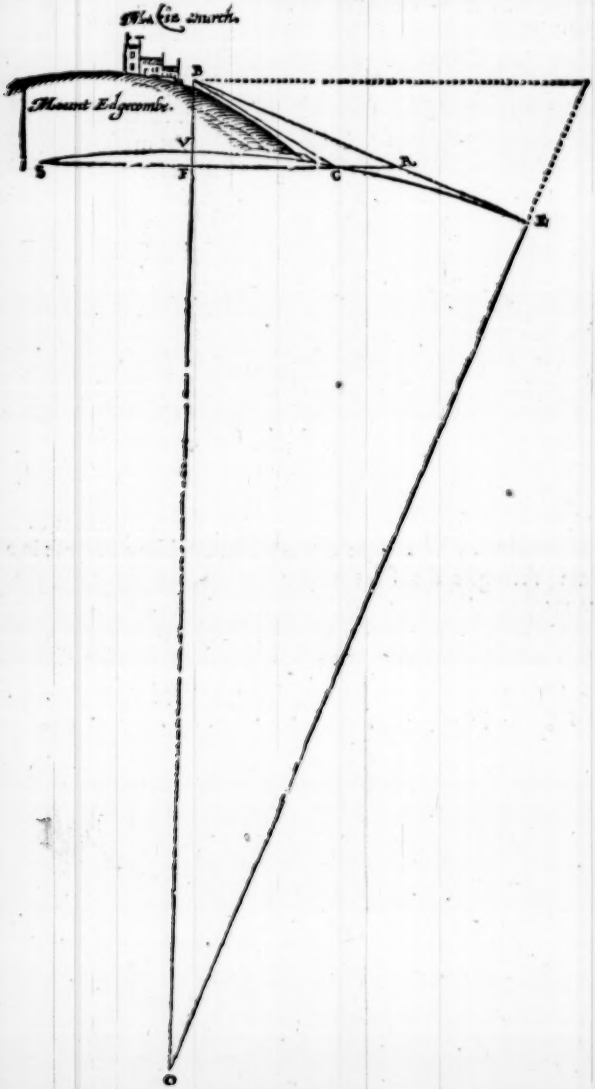
Out of theſe obſervations the ſemidiameter of the earth was found thus: Let O be the center of the earth, S V C E the circumference of the Sea: B the place of obſervation, B V F O a perpendicular line drawn from thence to the center of the earth:

BD,

B D, the line of Level or true Horizon: B C, the diſtance from the place of obſervation to the mark in the Sea 17,825 foot: the angle C B D found by obſervation 1. degree 14 minutes: B R E a viſuall line from the place of obſervation, touching the Sea: E, the point of touching: E B D, the angle betwixt that viſuall line and the line of Level or true Horizon, 22 minutes: R C F S, a Parallel to B D, or line of Level drawn by the mark C: O F V, and O P, ſemidiameters of the Seas circumference at the time of obſervation: E D, the continuation of the ſemidiameter O E to the line of Level or true Horizon B D.

Now in the Triangle B C F, right-angled at F, the ſide B C being 17,825 foot, and the angle at B, 88 degrees 46 minutes, (becauſe it is the complement of the angle C B D 1 degree 14 minutes) the ſide F C ſhall be 17,821 foot; which doubled maketh C F S 35,642 foot, and the angle at C (being the complement of the angle at B) is 1 degr. 14 minutes.

Then in the Triangle B C R, the angle at C (being the Complement of the angle B C F to a ſemi-circle) is 178 degrees 46 minutes, and the angle at B (being the difference of the angles D B R 22 min. and D B C, 1 degr. 14 minutes) ſhall be 52 min. and conſequently the angle at R (the complement of the two former, to two right angles) 22 min. Now becauſe in all plain Triangles the ſides and Sines of the oppoſite angles are proportional; therefore as 63,995 (the ſine of B R C 22 minutes, in ſuch parts whereof the whole Sine conteineth 10,000, 000) is to B C 17,825 foot; ſo is 151,256 the Sine of C B R 52 min. to C R 42,130 foot: which added to C F S 35,642 foot, giveth you the whole line R C F S. 77,772 foot.


Makie church.
Mount Edgecombe.
B
V
S
F
C
R
E
O

Alſo in the ſame Triangle as 63.995 the Sine of BRC 22 min. is to BC 17,825 foot; ſo is 215,241 the Sine of BCR 178 degrees 46 minutes, to BR 59,953 foot.

Moreover (by the 36 prop. 3 *Eucl.*) becauſe the oblong of the Secant RS, and the utter Segment thereof RC is equal to the ſquare of the Tangent RE; therefore multiplying SR 77,772 foot by RC 42,130 foot, the product will be 3,276.534,360, the ſquare root or ſide whereof is the line RE 57,241 foot: which added to BR 59,953 foot, maketh the whole line BRE 117,194 foot.

Laſtly, in the Triangle BOD, right-angled at B, becauſe the Tangent BE is perpendicular to OD by the 16 pr. 3. *Eucl.* therefore by the 8 pr. 6. *Eucl.* EBD and EOB are like Triangles, and conſequently the angle EOB equal to the angle EBD 22 minutes. Therefore BE and EO having the ſame proportion each to other that 6,399,628 the Tangent of BOE 22 min. hath to the whole Sine 100,000,000, the Tangent BRE being already found to be 117,194 foot, the Semidiameter of the Earth OE ſhall be 18,312,621 foot.

And as the ſame Tangent 6,399,628 is to 20477 the exceſſe of the ſecant of 22 min. above the whole Sine; ſo is BRE (117,194 foot) to VB (375 foot) the height of the place of obſervation above the convexitie of the Seas ſuperficies at the ſame time.

Hereby it may be eaſily found, how much the viſible or apparent Horizon is lower then the true Horizon, at any other height of the eye above the water, thus: As 375 is to 20477, ſo is any other height of the eye above the water to a number, which added to the whole Sine, maketh the Secant of the angle that ſheweth how much the apparent Horizon dippeth under the true Horizon at that height.

As for example: if the height of your eye above the water be 20 foot, you ſhall find by the former rule the fourth proportional number to be 1092, which added to the whole Sine 1,000,000,000, maketh 1,000,001,092; which is the ſecant of 5 min. 5 ſec. the angle of dipping anſwerable to that height.

After this manner was made this table here adjoyned; in the firſt columne wherof is ſet down the height of the eye above the water, from one foot to 50. The ſecond column ſheweth how much the viſual line touching the ſea, dippeth under the true Horizon, at any height of the eye above the water, not exceeding 50 foot. The uſe of which table is this: When you obſerve the height of the Sun or Stars at Sea with the Croſſe-ſtaffe, you

ſhall

shall also find out how many foot high your eye is above the water with a plumb-line or otherwise: seek that height in the first column of this Table; and in the second colume intituled *Angle of dipping*, you shall find the number of minutes and seconds that are to be subtracted from the apparent height of the Sun or Stars above the superficies of the Sea, observed with the Staffe, that you may have the apparent height above the true Horizon.

Height of the eye	*Angle of dipping*
Foot	*min. se*
1	1 8
2	1 36
3	1 58
4	2 16
5	2 33
6	2 47
7	3 0
8	3 13
9	3 24
10	3 35
12	3 56
14	4 15
16	4 33
18	4 40
20	5 5
22	5 20
24	5 3
26	5 48
28	6 1
30	6 13
32	6 25
34	6 38
36	6 49
38	7 0
40	7 11
42	7 21
44	7 32
46	7 42
48	7 52
50	8 2

The third error hath place in taking the height of the Sun or Moon with the Staffe, Ring, Quadrant, or Astrolabe, or any other Instrument, whether by Sea or Land: but in taking the height of the fixed Stars this error is not to be regarded, being altogether insensible, by reason of their exceeding great distance from the Earth, which is so much that in comparison thereof the semidiameter of the whole Earth hath not any sensible proportion, and therefore the fixed Stars cannot have any sensible Paralax. But the Sun by reason of his lesser distance from the Earth, hath a sensible Paralax, in so much that in taking his height we may for this cause onely be deceived sometimes about three minutes, by counting it lesse then indeed it is, and that especially in Winter Time, when the Sun draweth neer the Horizon: which although it be no great error, yet it is not altogether to be neglected in the rules and grounds of Art, which so much as is possible ought to be without error.

For this cause I have adjoyned this Table following of the Suns Paralax: the use whereof is this, in the first column intituled Suns height, look the Suns apparent height, and in the same line in the Second column, you shall have the Paralax of the Sun, which alwaies is to be added to the apparent height, that so you may have the true height of the Sun above the Horizon. As for example, admit I find the apparent height of the Sun to be 25 degrees therefore I seek that number in the first column, and in the Second column I find the Paralax answerable thereto to be two minutes, 44 seconds, which added to 25 degrees, make the

Suns height	*Suns Paralax*	
gr.	*M.*	*Sec.*
0	3	0
5	2	59
10	2	57
15	2	54
20	2	50
25	2	44
30	2	36
35	2	27
40	2	18
45	2	7
50	1	56
55	1	43
60	1	30
65	1	16
70	1	1
75	0	46
80	0	31
85	0	15

true

true height of the Sun to be 25 degrees, two minutes, 44 seconds.

A fourth cause of error is the refraction of the Beams of the Sun or Stars, which we observe, by reason of the Vaporous thickness of the ayre that is betwixt us and them, especially when they are neer the Horizon. For the finding whereof; not having hitherto had sufficient means by mine own observation for my full satisfaction herein: I have therefore thought good to adjoyne these Tables of the Suns and fixed Stars refractions out of *Tycho Brahe*, which differ little from such observations as I have made for triall hereof: the use wherof is this. In the first column seek the Altitude or height of the Sun or fixed Star, and in the second you shall have the refraction answering thereto, which being subtracted out of the observed height, you shall have the height of the Sun or Star remaining, without refraction.

The Altitude.	Suns Refraction.
De.	Mi. Se.
0	34 0
1	26 0
2	20 0
3	17 0
4	15 30
5	14 30
6	13 30
7	12 45
8	11 15
9	10 30
10	10 0
11	9 30
12	9 0
13	8 30
14	8 0
15	7 30
16	7 0
17	6 30
18	5 45
19	5 0
20	4 30
21	4 0
22	3 30

The Suns Altitude.	Suns Refraction.
De.	Mi. Se.
23	3 10
24	2 50
25	2 30
26	2 15
27	2 0
28	1 45
29	1 35
30	1 25
31	1 15
32	1 5
33	55
34	45
35	35
36	30
37	25
38	20
39	15
40	10
41	9
42	8
43	7
44	6
45	5

The fix St. Altitude.	Refraction.
De.	Mi. Se.
0	30 0
1	21 30
2	15 30
3	12 30
4	11 0
5	10 0
6	9 0
7	8 15
8	6 45
9	6 0
10	5 30
11	5 0
12	4 30
13	4 0
14	3 30
15	3 0
16	2 30
17	2 0
18	1 30
19	1 0
20	0 30
21	0 0

CHAP. XVI.

Faults amended in the Table of the Suns Declination: commonly called the Regiment of the Sun.

NOtwithstanding the Sun and Stars are at Sea the most certain markes and guides the Navigator hath, whereby he may direct himself to rectify his course, and know where he is after many turnings, and traversings this way and that way, especially in long Voiages, wherein he may be forced many times by contrary Winds and Calms, to sing with the *Poet* for many Weekes and Moneths together.

Cœlum undique & undique Pontus: and

Nihil eſt niſi Pontus & æther:

Yet the Tables of Declinations of the Sun and fixed Stars hitherto publiſhed, which I have compared together and examined by obſervation, are oft times very faulty: the declination of the Sun in them ſet down, being many times leſſe then truth, by 10, 11, or 12 minutes, eſpecially in the moneths of February and March: and ſome of the principal fixed Stars that are of moſt uſe in Navigation, differing in declination from that is ſet down in the Tables more then one whole degree, as I have found by many obſervations.

For the eaſier mending of theſe faults in the Tables of the Suns declination, I thought it meet, firſt, to ſet down the Table following, which ſheweth the declination of every minute of the Ecliptik in degrees, minutes, and ſeconds, whereby the place of the Sun is preſently known, his declination being firſt given by obſervation, and conſequently, his Eccentricity and Apogeum were eaſily found, and the Theorick of the Sun corrected: out of which the Ephemerides hereafter following, were calculated, ſhewing the true place of the Sun for every day of five years, agreeable, (without notable error) to the truth of the Heavens: and out of theſe with help of this Table of declination, a new Regiment (or Table of the Suns declination, for every day of five years) was moſt eaſily made: free from ſuch errors wherewith the Tables hitherto publiſhed and commonly uſed, have been too much peſtered: as by compariſon of this, and thoſe Tables with the obſervations hereafter following may evidently appeare.

Chap. XVII

Of the Table of declination of every minute of the Ecliptick in degrees, minutes and ſeconds: Made according to the greateſt obliquitie of the Zodiak this preſent age: which by exact obſervation, is found to bo 23 degrees 31 minutes and an halfe.

BEcauſe the table of declination here following, doth differ ſomething from the Table heretofore publiſhed by others, whereof ſome make the greateſt declination of the Sun to be 23 degr. and 28 minutes only, as *Copernicus* and his followers (according to which the Tables of declination and regiments of the Sun, that have been uſed for the moſt part by our Engliſh Mariners are made): whereas others of late, as

that

that noble Astronomer *Tycho Brahe* in his second book *De recentioribus ætherei mundi phænomenis*, findeth the same to be by his observations 23 degr. 27 mi. pag. 38. 23 degr. 31 mi. pag. 386. 23 degr. 31 mi. 30 sec. pag. 217. (according to which there is a Table of Declination already published by *Maginus*) and that excellent Geomettician *Regiomontanus* (whom *Petrus Nonius* compared by *Ramus* to *Archimedes* and *Clavius*, chose rather to follow) maketh it to be but 23 degr. 30 min. I thought it therefore needfull to shew what reasons moved me to make choise of the greatest of all the Declinations before recited, being thereunto induced, not only by the authoritie of that famous Astronomer of our time *Tycho Brahe*: but resting also upon many and diligent observations of mine owne, (taken by a quadrant of more then six foot semidiameter, so exactly made and divided into minutes and half minutes, as I could, and as heedfully used and truly rectified by Plumbline (every time I observed as my sight could discern:) All which observations do prove with one consent, that the greatest declination of the Sun in this our age, is 23 degrees, 31 minutes and an halfe; as thus it may appear.

In the year 1594 the 11 and 12 dayes of Iune, the apparent Meridian altitude of the Sun was observed to be 61 degr. 58 min. whereto the observations of the 8, 9, 10, 13, 14 and 15 days of the same moneth do well agree, wherein the apparent Meridian altitudes of the Sun, were 61 degr. 55 ½ mi. 61 degr. 56 ½ mi. 61 degr. 57 mi. 61 degr. 57 ½ mi. 61 degr. 57 mi. 61 degr. 56 mi. almost, as also the observations of the 9, 11, 12 and 13 dayes of Iune, in the year 1597 in which dayes the apparent Meridian altitudes of the Sun, were 61 degr. 57 mi. 61 degr. 58 ½ mi. almost, 61 degr. 58 mi. 61 degr. 57 ½ mi. By all which observations it may be certainly concluded, that the greatest apparent height of the Sun here at London, is 61 degr. and 58 minutes.

Moreover by many, and heedfull observations of the Pole-star, taken about the year 1593 and 1594 I found the greatest height thereof at that time here in London, to be 54 degrees, 24 minutes and an half, and the least height 48 degr. 39 ½ minutes the difference of which heights is 5 degrees 45 minutes: the half whereof is 2 degrees 52 ½ min. that is, (the distance of the Pole-star from the Pole) at that time added to the lowest height of the Pole-star, sheweth the height of the Pole at *London*, to be 51 degrees, 32 minutes: the complement whereof (38 degrees,

28 minutes) is the height of the Equinoctial, which ſubſtracted out of the greateſt apparent height of the Sun, 61 degrees 58 minutes: there remaineth the greateſt apparent declination of the Sun, 23 degrees 30 minutes: whereto if wee ad 1 minute 22, ſeconds, that is the parallax of the Sun anſwerable to that height, we ſhall have the greateſt true height of the Sun, 61 degrees, 59 minutes, 22 ſeconds: and conſequently the greateſt true declination of the Sun for our time, 23 degrees, 31 minutes, 22 ſeconds, differing but half a quarter of one minute from the greateſt declination finally determined and reſoluedly ſet down by *Tycho Brahe* for this our age 23 degrees, 31 minutes and one half.

Aries

m	Degr. 0 gr.	mi.	se.	di se	Degr. 1 gr.	m.	sec	di se.	Degr. 2 gr.	mi	sec	di se	3 gr.	mi.	se.	di se.	4 gr.	mi	se.	di se.	5 gr.	mi	se	di se.	m.
0	0	0	0	24	0	23	57	24	0	47	53	24	1	11	49	24	1	35	44	24	1	59	37	24	59
1	0	0	24	24	0	24	21	24	0	48	17	24	1	12	13	24	1	36	8	24	2	0	1	24	58
2	0	0	48	24	0	24	45	24	0	48	41	24	1	12	37	24	1	36	32	24	2	0	25	24	57
3	0	1	12	24	0	25	9	24	0	49	5	24	1	13	1	24	1	36	56	23	2	0	49	24	56
4	0	1	36	24	0	25	33	24	0	49	29	24	1	13	25	24	1	37	19	24	2	1	13	23	55
5	0	2	0	24	0	25	57	24	0	49	53	24	1	13	29	24	1	37	43	24	2	1	36	24	54
6	0	2	24	24	0	26	21	23	0	50	17	24	1	14	13	24	1	38	7	24	2	2	0	24	53
7	0	2	48	24	0	26	44	24	0	50	41	24	1	14	37	24	1	38	31	24	2	2	24	24	52
8	0	3	12	24	0	27	8	24	0	51	5	24	1	15	1	23	1	38	55	24	2	2	48	24	51
9	0	3	36	24	0	27	32	24	0	51	29	24	1	15	24	24	1	39	19	24	2	3	12	24	50
10	0	4	0	23	0	27	56	24	0	51	53	24	1	15	48	24	1	39	43	24	2	3	36	24	49
11	0	4	23	24	0	28	20	24	0	52	17	24	1	16	12	24	1	40	7	24	2	4	0	24	48
12	0	4	47	24	0	28	44	24	0	52	41	24	1	16	36	24	1	40	31	23	2	4	23	24	47
13	0	5	11	24	0	29	8	24	0	53	5	23	1	17	0	24	1	40	54	24	2	4	47	24	46
14	0	5	35	24	0	29	32	24	0	53	28	24	1	17	24	24	1	41	18	24	2	5	11	24	45
15	0	5	59	24	0	29	56	24	0	53	52	24	1	17	48	24	1	41	42	24	2	5	35	24	44
16	0	6	23	24	0	30	20	24	0	54	16	24	1	18	12	24	1	42	6	24	2	5	59	24	43
17	0	6	47	24	0	30	44	24	0	54	40	24	1	18	36	24	1	42	30	24	2	6	23	24	42
18	0	7	11	24	0	31	8	24	0	55	4	24	1	19	0	24	1	42	54	24	2	6	47	24	41
19	0	7	35	24	0	31	32	24	0	55	28	24	1	19	24	24	1	43	18	24	2	7	11	23	40
20	0	7	59	24	0	31	56	24	0	55	52	24	1	19	48	23	1	43	42	24	2	7	34	24	39
21	0	8	23	24	0	32	20	24	0	56	16	24	1	20	11	24	1	44	6	24	2	7	58	24	38
22	0	8	47	24	0	32	44	24	0	56	40	24	1	20	35	24	1	44	30	23	2	8	22	24	37
23	0	9	11	24	0	33	8	24	0	57	4	24	1	20	59	24	1	44	53	24	2	8	46	24	36
24	0	9	35	24	0	33	32	23	0	57	28	24	1	21	23	24	1	45	17	24	2	9	10	24	35
25	0	9	59	24	0	33	55	24	0	57	52	24	1	21	47	24	1	45	41	24	2	9	34	24	34
26	0	10	23	24	0	34	19	24	0	58	16	24	1	22	11	24	1	46	5	24	2	9	58	23	33
27	0	10	47	24	0	34	43	24	0	58	40	24	1	22	35	24	1	46	29	24	2	10	21	24	32
28	0	11	11	24	0	35	7	24	0	59	4	23	1	22	59	24	1	46	53	24	2	10	45	24	31
29	0	11	35	23	0	35	31	24	0	59	27	24	1	23	23	24	1	47	17	24	2	11	9	24	30
30	0	11	58	24	0	35	55	24	0	59	51	24	1	23	47	24	1	47	41	24	2	11	33	24	29
31	0	12	22	24	0	36	19	24	1	0	15	24	1	24	11	23	1	48	5	23	2	11	57	24	28
32	0	12	46	24	0	36	43	24	1	0	39	24	1	24	34	24	1	48	28	24	2	12	21	24	27
33	0	13	10	24	0	37	7	24	1	1	3	24	1	24	58	24	1	48	52	24	2	12	45	23	26
34	0	13	34	24	0	37	31	24	1	1	27	24	1	25	22	24	1	49	16	24	2	13	8	24	25
35	0	13	58	24	0	37	55	24	1	1	51	24	1	25	46	24	1	49	40	24	2	13	32	24	24
36	0	14	22	24	0	38	19	24	1	2	15	24	1	26	10	24	1	50	4	24	2	13	56	24	23
37	0	14	46	24	0	38	43	24	1	2	39	24	1	26	34	24	1	50	28	24	2	14	20	24	22
38	0	15	10	24	0	39	7	24	1	3	3	24	1	26	58	24	1	50	52	24	2	14	44	24	21
39	0	15	34	24	0	39	37	24	1	3	27	24	1	27	22	24	1	51	16	23	2	15	8	23	20
40	0	15	58	24	0	39	55	24	1	3	51	24	1	27	46	24	1	51	39	24	2	15	31	24	19
41	0	16	22	24	0	40	19	24	1	4	15	24	1	28	10	24	1	52	3	24	2	15	55	24	18
42	0	16	46	24	0	40	42	24	1	4	39	23	1	28	34	23	1	52	27	24	2	16	19	24	17
43	0	17	10	24	0	41	6	24	1	5	2	24	1	28	57	24	1	52	51	24	2	16	43	24	16
44	0	17	34	24	0	41	30	24	1	5	26	24	1	29	21	24	1	53	15	24	2	17	7	24	15
45	0	17	58	24	0	41	54	24	1	5	50	24	1	29	45	24	1	53	39	24	2	17	31	24	14
46	0	18	22	24	0	42	18	24	1	6	14	24	1	30	9	24	1	54	3	24	2	17	55	23	13
47	0	18	46	24	0	42	42	24	1	6	38	24	1	30	33	24	1	54	27	24	2	18	18	24	12
48	0	19	10	23	0	43	6	24	1	7	2	24	1	30	57	24	1	54	51	23	2	18	42	24	11
49	0	19	33	24	0	43	30	24	1	7	26	24	1	31	21	24	1	55	14	24	2	19	6	24	10
50	0	19	57	24	0	43	54	24	1	7	50	24	1	31	45	24	1	55	38	24	2	19	30	24	9
51	0	20	21	24	0	44	18	24	1	8	14	24	1	32	9	24	1	56	2	24	2	19	54	24	8
52	0	20	45	24	0	44	42	24	1	8	38	24	1	32	33	24	1	56	26	24	2	20	18	23	7
53	0	21	9	24	0	45	6	24	1	9	2	24	1	32	57	23	1	56	50	24	2	20	41	24	6
54	0	21	33	24	0	45	30	24	1	9	26	24	1	33	20	24	1	57	14	24	2	21	5	24	5
55	0	21	57	24	0	45	54	24	1	9	50	23	1	33	44	24	1	57	38	24	2	21	29	24	4
56	0	22	21	24	0	46	18	24	1	10	13	24	1	34	8	24	1	58	2	23	2	21	53	24	3
57	0	22	45	24	0	46	42	24	1	10	37	24	1	34	32	24	1	58	25	24	2	22	17	24	2
58	0	23	9	24	0	47	6	23	1	11	1	24	1	34	56	24	1	58	49	24	2	22	41	24	1
59	0	23	33	24	0	47	29	24	1	11	25	24	1	35	20	24	1	59	13	24	2	22	5	23	0
	29				28				27				26				25				24				

m	6 gr. mi. se	di f.	7 gr. mi	di se.	8 gr. mi se	di f.	9 gr. mi. se.	di se	10 gr. mi. se	di se.	11 gr. mi sec	di se.	m
0	2 23 28	24	2 47 18	23	3 11 4	24	3 34 48	23	3 58 28	24	4 22 5	23	59
1	2 23 52	24	2 47 41	24	3 11 28	24	3 35 11	24	3 58 52	23	4 22 28	24	58
2	2 24 16	24	2 48 5	24	3 11 52	23	3 35 35	24	3 59 15	24	4 22 52	23	57
3	2 24 40	24	2 48 29	24	3 12 15	24	3 35 59	23	3 59 39	24	4 23 15	24	56
4	2 25 4	24	2 48 53	24	3 12 39	24	3 36 22	24	4 0 3	23	4 23 39	23	55
5	2 25 28	23	2 49 17	23	3 13 3	24	3 36 46	24	4 0 26	24	4 24 2	24	54
6	2 25 51	24	2 49 40	24	3 13 27	23	3 37 10	24	4 0 50	23	4 24 26	24	53
7	2 26 15	24	2 50 4	24	3 13 50	24	3 37 34	23	4 1 13	24	4 24 50	23	52
8	2 26 39	24	2 50 28	24	3 14 14	24	3 37 57	24	4 1 37	24	4 25 13	24	51
9	2 27 3	24	2 50 52	23	3 14 38	24	3 38 21	24	4 2 1	23	4 25 37	23	50
10	2 27 27	24	2 51 15	24	3 15 2	23	3 38 45	23	4 2 24	24	4 26 0	24	49
11	2 27 51	23	2 51 39	24	3 15 25	24	3 39 8	24	4 2 48	24	4 26 24	23	48
12	2 28 14	24	2 52 3	24	3 15 49	24	3 39 32	24	4 3 12	23	4 26 47	24	47
13	2 28 38	24	2 52 27	24	3 16 13	24	3 39 56	23	4 3 35	24	4 27 11	24	46
14	2 29 2	24	2 52 51	23	3 16 37	23	3 40 19	24	4 3 59	24	4 27 35	23	45
15	2 29 26	24	2 53 15	24	3 17 0	24	3 40 43	24	4 4 23	23	4 27 58	24	44
16	2 29 50	24	2 53 38	24	3 17 24	24	3 41 7	23	4 4 46	24	4 28 22	23	43
17	2 30 14	23	2 54 2	24	3 17 48	24	3 41 30	24	4 5 10	23	4 28 45	24	42
18	2 30 37	24	2 54 26	24	3 18 12	23	3 41 54	24	4 5 33	24	4 29 9	23	41
19	2 31 1	24	2 54 50	23	3 18 35	24	3 42 18	24	4 5 57	24	4 29 32	24	40
20	2 31 25	24	2 55 13	24	3 18 59	24	3 42 42	23	4 6 21	23	4 29 56	23	39
21	2 31 49	24	2 55 37	24	3 19 23	23	3 43 5	24	4 6 44	24	4 30 19	24	38
22	2 32 13	23	2 56 1	24	3 19 46	24	3 43 29	24	4 7 8	23	4 30 43	24	37
23	2 32 36	24	2 56 25	23	3 20 10	24	3 43 53	23	4 7 31	24	4 31 7	23	36
24	2 33 0	24	2 56 48	24	3 20 34	24	3 44 16	24	4 7 55	24	4 31 30	24	35
25	2 33 24	24	2 57 12	24	3 20 58	23	3 44 40	24	4 8 19	23	4 31 54	23	34
26	2 33 48	24	2 57 36	24	3 21 21	24	3 45 4	23	4 8 42	24	4 32 17	24	33
27	2 34 12	24	2 58 0	24	3 21 45	24	3 45 17	24	4 9 6	24	4 32 41	23	32
28	2 34 36	23	2 58 24	24	3 22 9	24	3 45 51	24	4 9 30	23	4 33 4	24	31
29	2 34 59	24	2 58 47	23	3 22 33	23	3 46 15	23	4 9 53	24	4 33 28	23	30
30	2 35 23	24	2 59 11	24	3 22 56	24	3 46 38	24	4 10 17	23	4 33 51	24	29
31	2 35 47	24	2 59 35	24	3 23 20	24	3 47 2	24	4 10 40	24	4 34 15	24	28
32	2 36 11	24	2 59 59	23	3 23 44	23	3 47 26	23	4 11 4	24	4 34 39	23	27
33	2 36 35	24	3 0 22	24	3 24 7	24	3 47 49	24	4 11 28	23	4 35 2	24	26
34	2 36 59	23	3 0 46	24	3 24 31	24	3 48 13	24	4 11 51	24	4 35 26	23	25
35	2 37 22	24	3 1 10	24	3 24 55	24	3 48 37	23	4 12 15	23	4 35 49	24	24
36	2 37 46	24	3 1 34	24	3 25 19	23	3 49 0	24	4 12 38	24	4 36 13	23	23
37	2 38 10	24	3 1 58	23	3 25 42	24	3 49 24	24	4 13 2	24	4 36 36	24	22
38	2 38 34	24	3 2 21	24	3 26 6	24	3 49 48	23	4 13 26	23	4 37 0	23	21
39	2 38 58	23	3 2 45	24	3 26 30	24	3 50 11	24	4 13 49	24	4 37 23	24	20
40	2 39 21	24	3 3 9	24	3 26 54	23	3 59 35	24	4 14 13	23	4 37 47	23	19
41	2 39 45	24	3 3 33	23	3 27 17	24	3 50 59	23	4 14 36	24	4 38 10	24	18
42	2 40 9	24	3 3 56	24	3 27 41	24	3 51 22	24	4 15 0	24	4 38 34	23	17
43	2 40 33	24	3 4 20	24	3 28 5	23	3 51 46	24	4 15 24	23	4 38 57	24	16
44	2 40 57	23	3 4 44	24	3 28 28	24	3 52 10	23	4 16 47	24	4 39 21	23	15
45	2 41 20	24	3 5 8	23	3 28 52	24	3 52 33	24	4 16 11	23	4 39 44	24	14
46	2 41 44	24	3 5 31	24	3 29 16	24	3 52 57	24	4 16 34	24	4 40 8	23	13
47	2 42 8	24	3 5 55	24	3 29 40	23	3 53 21	25	4 16 58	24	4 40 31	24	12
48	2 42 32	24	3 6 19	24	3 30 3	24	3 53 44	24	4 17 22	23	4 40 55	24	11
49	2 42 56	24	3 6 43	24	3 30 27	24	3 54 8	24	4 17 45	24	4 41 19	23	10
50	2 43 20	23	3 7 7	23	3 30 51	23	3 54 32	23	4 18 9	23	4 41 42	24	9
51	2 43 43	24	3 7 30	24	3 31 14	24	3 54 55	24	4 18 32	24	4 42 6	23	8
52	2 44 7	24	3 7 54	24	3 31 38	24	3 55 19	23	4 18 56	24	4 42 29	24	7
53	2 44 31	24	3 8 18	24	3 32 2	23	3 55 42	24	4 19 20	23	4 42 53	23	6
54	2 44 55	24	3 8 42	23	3 32 25	24	3 56 6	24	4 19 43	24	4 43 16	24	5
55	2 45 19	23	3 9 5	24	3 32 49	24	3 56 30	23	4 20 7	23	4 43 40	23	4
56	2 45 42	24	3 9 29	24	3 33 13	24	3 56 53	24	4 20 30	24	4 44 3	24	3
57	2 46 6	24	3 9 53	24	3 33 37	23	3 57 17	24	4 20 54	23	4 44 27	23	2
58	2 46 30	24	3 10 17	23	3 34 0	24	3 57 41	23	4 21 17	24	4 44 50	24	1
59	2 46 54	24	3 10 40	24	3 34 24	24	3 58 4	24	4 21 41	24	4 45 14	23	0
m	23		22		21		20		19		18		m

Virgo Pisces

m	12 gr.	mi.	se.	di se	13 gr.	mi.	se	di se	14 gr.	mi.	se	di se	15 gr.	mi	s.	di s.	16 gr.	mi.	s.	di s.	17 gr.	mi.	s.	di s.	m
0	4	45	37	23	5	9	5	24	5	32	29	23	5	55	47	23	6	18	59	24	6	42	6	23	59
1	4	46	0	24	5	9	29	23	5	32	52	23	5	56	10	23	6	19	23	23	6	42	29	23	58
2	4	46	24	24	5	9	52	24	5	33	15	24	5	56	33	23	6	19	46	23	6	42	52	23	57
3	4	46	48	23	5	10	16	23	5	33	39	23	5	56	56	24	6	20	9	23	6	43	15	23	56
4	4	47	11	24	5	10	39	23	5	34	2	23	5	57	20	23	6	20	32	23	6	43	38	23	55
5	4	47	35	23	5	11	2	24	5	34	25	24	5	57	43	23	6	20	55	23	6	44	1	23	54
6	4	47	58	24	5	11	26	23	5	34	49	23	5	58	6	24	6	21	18	23	6	44	24	23	53
7	4	48	22	23	5	11	49	24	5	35	12	23	5	58	30	23	6	21	41	24	6	44	47	23	52
8	4	48	45	24	5	12	13	23	5	35	35	24	5	58	53	23	6	22	5	23	6	45	10	24	51
9	4	49	9	23	5	12	36	24	5	35	59	23	5	59	16	23	6	22	28	23	6	45	34	23	50
10	4	49	32	24	5	13	0	23	5	36	22	23	5	59	39	24	6	22	51	23	6	45	57	23	49
11	4	49	56	23	5	13	23	23	5	36	45	24	6	0	3	23	6	23	14	23	6	46	20	23	48
12	4	50	19	24	5	13	46	24	5	37	9	23	6	0	26	23	6	23	37	23	6	46	43	23	47
13	4	50	43	23	5	14	10	23	5	37	32	23	6	0	49	23	6	24	0	23	6	47	6	23	46
14	4	51	6	24	5	14	33	23	5	37	55	24	6	1	12	23	6	24	23	24	6	47	29	23	45
15	4	51	30	23	5	14	56	24	5	38	19	23	6	1	35	24	6	24	47	23	6	47	52	23	44
16	4	51	53	24	5	15	20	23	5	38	42	23	6	1	59	23	6	25	10	23	6	48	15	23	43
17	4	52	17	23	5	15	43	24	5	39	5	24	6	2	22	23	6	25	33	23	6	48	38	23	42
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19	4	53	4	23	5	16	30	23	5	39	52	23	6	3	8	24	6	26	19	23	6	49	24	23	40
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22	4	54	14	24	5	17	40	24	5	41	2	23	6	4	18	23	6	27	29	23	6	50	33	23	37
23	4	54	38	23	5	18	4	23	5	41	25	24	6	4	41	23	6	27	52	23	6	50	56	23	36
24	4	55	1	23	5	18	27	23	5	41	49	23	6	5	5	23	6	28	15	23	6	51	19	23	35
25	4	55	24	24	5	18	50	24	5	42	12	23	6	5	28	23	6	28	38	23	6	51	42	23	34
26	4	55	48	23	5	19	14	23	5	42	35	23	6	5	51	23	6	29	1	23	6	52	5	23	33
27	4	56	11	24	5	19	37	24	5	42	58	24	6	6	14	23	6	29	24	23	6	52	28	23	32
28	4	56	35	23	5	20	1	23	5	43	22	23	6	6	37	24	6	29	47	23	6	52	51	23	31
29	4	56	58	24	5	20	24	24	5	43	45	23	6	7	1	23	6	30	10	23	6	53	14	23	30
30	4	57	22	23	5	20	48	23	5	44	8	24	6	7	24	23	6	30	33	24	6	53	37	23	29
31	4	57	45	24	5	21	11	23	5	44	32	23	6	7	47	23	6	30	57	23	6	54	0	23	28
32	4	58	9	23	5	21	34	24	5	44	55	23	6	8	10	23	6	31	20	23	6	54	23	23	27
33	4	58	32	24	5	21	58	23	5	45	18	24	6	8	33	24	6	31	43	23	6	54	46	23	26
34	4	58	56	23	5	22	21	24	5	45	42	23	6	8	57	23	6	32	6	23	6	55	9	23	25
35	4	59	19	24	5	22	45	23	5	46	5	23	6	9	20	23	6	32	29	23	6	55	32	23	24
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37	5	0	6	24	5	23	31	24	5	46	51	24	6	10	6	23	6	33	15	23	6	56	18	23	22
38	5	0	30	23	5	23	55	23	5	47	15	23	6	10	29	24	6	33	38	23	6	56	41	23	21
39	5	0	53	23	5	24	18	23	5	47	38	23	6	10	53	23	6	34	1	24	6	57	4	23	20
40	5	1	16	24	5	24	41	24	5	48	1	24	6	11	16	23	6	34	25	23	6	57	27	23	19
41	5	1	40	23	5	25	5	23	5	48	25	23	6	11	39	23	6	34	48	23	6	57	50	23	18
42	5	2	3	24	5	25	28	23	5	48	48	23	6	12	2	23	6	35	11	23	6	58	13	23	17
43	5	2	27	23	5	25	51	24	5	49	11	23	6	12	25	24	6	35	34	23	6	58	36	23	16
44	5	2	50	24	5	26	15	23	5	49	34	24	6	12	49	23	6	35	57	23	6	58	59	23	15
45	5	3	14	23	5	26	38	24	5	49	58	23	6	13	15	23	6	36	20	23	6	59	22	23	14
46	5	3	37	24	5	27	2	23	5	50	21	23	6	13	35	23	6	36	43	23	6	59	45	23	13
47	5	4	1	23	5	27	25	23	5	50	44	24	6	13	58	23	6	37	6	23	7	0	8	23	12
48	5	4	24	23	5	27	48	24	5	51	8	23	6	14	21	24	6	37	29	23	7	0	31	23	11
49	5	4	47	24	5	28	12	23	5	51	31	23	6	14	45	23	6	37	52	23	7	0	54	23	10
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54	5	6	45	23	5	30	9	23	5	53	27	23	6	16	40	24	6	39	48	23	7	2	49	23	5
55	5	7	8	24	5	30	32	23	5	53	50	24	6	17	4	23	6	40	11	23	7	3	12	23	4
56	5	7	32	23	5	30	55	24	5	54	14	23	6	17	27	23	6	40	3	23	7	3	35	23	3
57	5	7	55	23	5	31	19	25	5	54	37	23	6	17	50	23	6	40	57	23	7	3	58	23	2
58	5	8	18	24	5	31	42	23	5	55	0	24	6	16	13	23	6	41	20	23	7	4	21	23	1
59	5	8	42	23	5	32	5	23	5	55	24	23	6	18	30	23	6	41	43	23	7	4	44	22	0
m	17				16				15				14				13				12				m

Virgo

m.	18 gr.	mi.	di se	19 gr.	mi.	di se	20 gr.	mi.	di s.	21 gr.	mi.	di s.	22 gr.	mi.	di se.	23 gr.	mi.	di se	m
0	7	5	6 23	7	28	0 23	7	50	47 23	8	13	26 23	8	35	58 22	8	58	21 22	59
1	7	5	29 23	7	28	23 23	7	51	10 22	8	13	49 22	8	36	20 23	8	58	43 23	58
2	7	5	52 23	7	28	46 23	7	51	32 23	8	14	11 23	8	36	43 22	8	59	6 22	57
3	7	6	15 23	7	29	9 23	7	51	55 23	8	14	34 22	8	37	5 22	8	59	28 22	56
4	7	6	38 23	7	29	32 22	7	52	18 22	8	14	56 23	8	37	27 23	8	59	50 22	55
5	7	7	1 23	7	29	54 23	7	52	40 23	8	15	19 23	8	37	50 22	9	0	12 23	54
6	7	7	24 23	7	30	17 23	7	53	3 23	8	15	42 22	8	38	12 23	9	0	35 22	53
7	7	8	47 23	7	30	40 23	7	53	26 23	8	16	4 23	8	38	35 22	9	0	57 22	52
8	7	8	10 23	7	31	3 23	7	53	49 22	8	16	27 22	8	38	57 23	9	1	16 23	51
9	7	8	33 23	7	31	26 22	7	54	11 23	8	16	49 23	8	39	20 22	9	1	42 22	50
10	7	8	56 23	7	31	48 23	7	54	34 23	8	17	12 23	8	39	42 23	9	2	4 22	49
11	7	9	19 23	7	32	11 23	7	54	57 22	8	17	35 22	8	40	5 22	9	2	26 23	48
12	7	9	42 23	7	32	34 23	7	55	19 23	8	17	57 23	8	40	27 22	9	2	49 22	47
13	7	10	5 23	7	32	57 23	7	55	42 23	8	18	20 22	8	40	49 23	9	3	11 22	46
14	7	10	28 22	7	33	20 23	7	56	5 22	8	18	42 23	8	41	12 22	9	3	33 22	45
15	7	10	51 23	7	33	43 22	7	56	27 23	8	19	5 22	8	41	34 23	9	3	55 22	44
16	7	11	13 23	7	34	5 23	7	56	50 23	8	19	27 23	8	41	57 22	9	4	18 22	43
17	7	11	36 23	7	34	28 23	7	57	13 22	8	19	50 22	8	42	19 22	9	4	40 22	42
18	7	11	59 23	7	34	51 23	7	57	35 23	8	20	12 23	8	42	41 23	9	5	2 23	41
19	7	12	22 23	7	35	14 23	7	57	58 23	8	20	35 23	8	43	4 22	9	5	25 22	40
20	7	12	45 23	7	35	37 22	7	58	21 22	8	20	58 22	8	43	26 23	9	5	47 22	39
21	7	13	8 23	7	35	59 23	7	58	43 23	8	21	20 23	8	43	49 22	9	6	9 22	38
22	7	13	31 23	7	36	22 23	7	59	6 23	8	21	43 22	8	44	11 23	9	6	31 23	37
23	7	13	54 23	7	36	45 23	7	59	29 22	8	22	5 23	8	44	34 22	9	6	54 22	36
24	7	14	17 23	7	37	8 23	7	59	51 22	8	22	28 22	8	44	56 22	9	7	16 22	35
25	7	14	40 23	7	37	31 22	8	0	14 23	8	22	50 23	8	45	18 23	9	7	38 22	34
26	7	15	3 22	7	37	53 23	8	0	37 22	8	23	13 22	8	45	41 22	9	8	0 23	33
27	7	15	25 23	7	38	16 23	8	0	59 23	8	23	35 23	8	46	3 23	9	8	23 22	32
28	7	15	48 23	7	38	39 23	8	1	22 23	8	23	58 22	8	46	26 22	9	8	45 22	31
29	7	16	11 23	7	39	2 22	8	2	45 23	8	24	20 23	8	46	48 22	9	9	7 22	30
30	7	16	34 23	7	39	24 23	8	2	8 23	8	24	43 22	8	47	10 23	9	9	29 23	29
31	7	16	57 23	7	39	47 23	8	2	31 23	8	25	5 23	8	47	33 22	9	9	52 22	28
32	7	17	20 23	7	40	10 23	8	2	54 22	8	25	28 22	8	47	55 22	9	10	14 22	27
33	7	17	43 23	7	40	33 23	8	3	16 23	8	25	50 23	8	48	17 23	9	10	36 22	26
34	7	18	6 23	7	40	56 22	8	3	39 23	8	26	13 22	8	48	40 22	9	10	58 23	25
35	7	18	29 23	7	41	18 23	8	4	2 22	8	26	35 23	8	49	2 23	9	11	12 22	24
36	7	18	52 22	7	41	41 23	8	4	24 23	8	26	58 23	8	49	25 22	9	11	43 22	23
37	7	19	14 23	7	42	4 23	8	4	47 22	8	27	21 22	8	49	47 22	9	12	5 22	22
38	7	19	37 23	7	42	27 22	8	5	9 22	8	27	43 23	8	50	9 23	9	12	27 23	21
39	7	20	0 23	7	42	49 23	8	5	31 23	8	28	6 22	8	50	32 22	9	12	50 22	20
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41	7	20	46 23	7	43	35 23	8	6	17 22	8	28	51 22	8	51	16 23	9	13	34 22	18
42	7	21	9 23	7	43	58 22	8	6	39 23	8	29	13 23	8	51	39 22	9	13	56 22	17
43	7	21	32 23	7	44	20 23	8	7	2 22	8	29	36 22	8	52	1 23	9	14	18 23	16
44	7	21	55 22	7	44	43 23	8	7	24 23	8	29	58 23	8	52	24 22	9	14	41 22	15
45	7	22	17 23	7	45	6 23	8	7	47 23	8	30	21 22	8	52	46 22	9	15	3 22	14
46	7	22	40 23	7	45	29 22	8	8	10 22	8	30	43 22	8	53	8 23	9	15	25 22	13
47	7	23	3 23	7	45	51 23	8	8	32 23	8	31	5 23	8	53	31 22	9	15	47 22	12
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49	7	23	49 23	7	46	37 23	8	9	18 22	8	31	50 23	8	54	15 23	9	16	32 22	10
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52	7	24	57 23	7	47	45 23	8	10	25 23	8	32	58 22	8	55	22 23	9	17	38 22	7
53	7	25	20 23	7	48	8 23	8	10	48 23	8	33	20 23	8	55	45 22	9	18	0 23	6
54	7	25	43 23	7	48	31 22	8	11	11 22	8	33	43 22	8	56	7 22	9	18	23 22	5
55	7	26	6 23	7	48	53 23	8	11	33 23	8	34	5 23	8	56	29 22	9	18	45 22	4
56	7	26	29 23	7	49	16 23	8	11	56 22	8	34	28 22	8	56	51 23	9	19	7 22	3
57	7	26	52 23	7	49	39 22	8	12	18 23	8	34	50 23	8	57	14 22	9	19	29 22	2
58	7	27	15 22	7	50	1 23	8	12	41 23	8	35	13 22	8	57	36 23	9	19	51 23	1
60	7	27	37 23	7	50	24 23	8	13	4 23	8	35	35 22	8	57	59 22	9	20	14 22	0

11 10 9 8 7 6

m.	24 gr.	24 mi.	24 se.	di se.	25 gr.	25 mi.	25 sec	di se.	26 gr.	26 mi.	26 se.	di se.	27 gr.	27 mi.	27 se.	di se.	28 gr.	28 mi.	28 se	di s.	29 gr.	29 mi.	29 se.	di s.	M
0	9	20	36	22	9	42	42	22	10	4	38	22	10	26	25	22	10	48	2	21	♍ 9	38	21	59	
1	9	20	58	22	9	43	4	22	10	5	0	22	10	26	47	21	10	48	23	22	11	9	49	22	58
2	9	21	20	22	9	43	26	22	10	5	22	22	10	27	8	22	10	48	45	21	11	10	11	21	57
3	9	21	42	22	9	43	48	22	10	5	44	21	10	27	30	22	10	49	6	22	11	10	32	21	56
4	9	22	4	23	9	44	10	22	10	6	5	22	10	27	52	21	10	49	28	21	11	10	53	22	55
5	9	22	27	22	9	44	32	22	10	6	27	22	10	28	13	22	10	49	49	22	11	11	15	21	54
6	9	22	49	22	9	44	54	22	10	6	49	22	10	28	35	22	10	50	11	21	11	11	36	21	53
7	9	23	11	22	9	45	16	22	10	7	11	22	10	28	57	21	10	50	32	22	11	11	57	22	52
8	9	23	33	22	9	45	38	22	10	7	33	22	10	29	18	22	10	50	54	21	11	12	19	21	51
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13	9	25	24	22	9	47	28	22	10	9	22	22	10	31	7	21	10	52	41	22	11	14	5	22	46
14	9	25	46	22	9	47	50	22	10	9	44	22	10	31	28	22	10	53	3	21	11	14	27	21	45
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16	9	26	30	22	9	48	34	22	10	10	27	22	10	32	12	21	10	53	46	21	11	15	9	22	43
17	9	26	52	22	9	48	56	21	10	10	49	22	10	32	33	22	10	54	7	22	11	15	31	21	42
18	9	27	14	23	9	49	17	22	10	11	11	22	10	32	55	22	10	54	29	21	11	15	52	21	41
19	9	27	37	22	9	49	39	22	10	11	33	22	10	33	17	21	10	54	50	22	11	16	13	21	40
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21	9	28	21	22	9	50	23	22	10	12	17	21	10	34	0	22	10	55	33	22	11	16	56	21	38
22	9	28	43	22	9	50	45	22	10	12	38	22	10	34	22	21	10	55	55	21	11	17	17	21	37
23	9	29	5	23	9	51	7	22	10	13	0	22	10	34	43	22	10	56	16	21	11	17	38	22	36
24	9	29	27	22	9	51	29	22	10	13	22	22	10	35	5	21	10	56	37	22	11	18	0	21	35
25	9	29	49	22	9	51	51	22	10	13	44	22	10	35	26	22	10	56	59	21	11	18	21	21	34
26	9	30	11	22	9	52	13	22	10	14	6	21	10	35	48	22	10	57	20	22	11	18	42	21	33
27	9	30	33	23	9	52	35	22	10	14	27	22	10	36	10	21	10	57	42	21	11	19	3	22	32
28	9	30	56	22	9	52	57	22	10	14	49	22	10	36	31	22	10	58	3	22	11	19	25	21	31
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33	15	39	34	18	15	57	45	18	16	15	40	18	16	33	18	18		50	40	17		7	43	17	26
34	15	39	52	18	15	58	3	18	16	15	58	18	16	33	36	17		50	57	17		8	0	17	25
35	15	40	10	19	15	58	31	18	16	16	16	17	16	33	53	18		51	14	17		8	17	17	24
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37	15	40	47	18	15	58	57	18	16	16	51	18	16	34	28	18		51	48	18		8	51	17	22
38	15	41	5	19	15	59	15	18	16	17	9	18	16	34	46	17		52	6	17		9	8	17	21
39	15	41	24	18	15	59	33	18	16	17	27	17	16	35	3	18		52	23	17		9	25	17	20
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41	15	42	0	19	16	0	9	18	16	18	2	18	16	35	38	18		52	57	17		9	58	17	18
42	15	42	19	18	16	0	27	18	16	18	20	18	16	35	56	17		53	14	17		10	15	17	17
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45	15	43	13	19	16	1	21	18	16	19	13	18	16	36	48	18		54	6	17		11	6	17	14
46	15	43	32	18	19	1	39	18	16	19	31	18	16	37	6	17		54	23	17		11	23	17	13
47	15	43	50	18	16	1	57	18	16	19	49	17	16	37	23	17		54	40	17		11	40	16	12
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56	15	46	34	18	16	4	39	18	16	22	28	17	16	40	0	17		57	14	17		14	11	17	3
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59	15	47	29	18	16	5	33	18	16	23	21	17	16	40	52	17		58	5	17		15	1	17	0
		17			16			15			14			13			12			

M	18 gr. mi. se.	di s.	19 gr. mi. se.	di s.	20 gr. mi. s.	di s.	21 gr. mi. se.	di s.	22 gr. mi. se	di s.	23 gr. mi. se	di s.	M
0	17 15 18	17	17 31 56	16	17 48 15	16	18 4 16	16	18 19 58	15	18 35 20	15	59
1	17 15 35	17	17 32 12	17	17 48 31	17	18 4 32	16	18 20 13	16	35 35	15	58
2	15 52	16	32 29	16	48 48	16	4 48	16	20 29	15	35 50	15	57
3	16 8	17	32 45	17	49 4	16	5 4	15	20 44	16	36 5	16	56
4	16 25	17	33 2	16	49 20	16	5 19	16	21 0	15	36 21	15	55
5	16 42	17	33 18	17	49 36	16	5 35	16	21 15	16	36 36	15	54
6	16 59	16	33 35	16	49 52	16	5 51	16	21 31	15	39 51	15	53
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8	17 32	17	34 8	16	50 24	17	6 23	15	22 2	15	37 21	15	51
9	17 49	17	34 24	16	50 41	16	6 38	16	22 17	16	37 36	16	50
10	18 6	16	34 40	17	50 57	16	6 54	16	22 33	15	37 52	15	49
11	18 22	17	34 57	16	51 13	16	7 10	16	22 48	16	38 7	15	48
12	18 39	17	35 13	17	51 29	16	7 26	16	23 4	15	38 22	15	47
13	18 56	16	35 30	16	51 45	16	7 42	15	23 19	16	38 37	15	46
14	19 12	17	35 46	17	52 1	16	7 57	16	23 35	15	38 52	15	45
15	19 29	17	36 3	16	52 17	16	8 13	16	23 50	15	39 7	15	44
16	19 46	17	36 19	16	52 33	16	8 29	16	24 5	16	39 22	16	43
17	20 3	16	36 35	17	52 49	17	8 45	15	24 21	15	39 38	15	42
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19	20 36	17	37 8	16	53 22	16	9 16	16	24 52	15	40 8	15	40
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21	21 9	17	37 41	16	53 54	16	9 48	15	25 23	15	40 38	15	38
22	21 26	17	37 57	17	54 10	16	10 3	16	25 38	15	40 53	15	37
23	21 43	16	38 14	16	54 26	16	10 19	16	25 53	16	41 8	15	36
24	21 59	17	38 30	16	54 42	16	10 35	16	26 9	15	41 25	15	35
25	22 16	17	38 46	17	54 58	16	10 51	15	26 24	16	41 38	15	34
26	22 33	16	39 3	16	55 14	16	11 6	16	26 50	15	41 53	15	33
27	22 49	17	39 39	16	55 30	16	11 22	16	26 55	15	42 8	15	32
28	23 6	17	39 35	17	56 46	16	11 38	16	27 10	16	42 23	15	31
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30	23 39	17	40 8	16	56 18	16	12 9	16	27 41	16	42 54	15	29
31	23 56	17	40 24	17	56 34	16	12 25	16	27 57	15	43 9	15	28
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34	24 46	16	41 13	16	57 22	16	13 12	16	28 43	15	43 54	15	25
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36	25 19	17	41 46	16	57 54	16	13 43	16	29 13	16	44 24	15	23
37	25 36	16	42 2	16	58 10	16	13 59	16	29 29	15	44 39	15	22
38	25 52	17	42 18	17	58 26	16	14 15	15	29 44	15	44 54	15	21
39	26 9	16	42 35	16	58 42	16	14 30	16	29 59	16	45 9	15	20
40	26 25	17	42 51	16	58 58	16	14 46	16	30 15	15	45 24	15	19
41	26 42	17	43 7	16	59 14	16	15 2	15	30 30	15	45 39	15	18
42	26 59	16	43 23	17	59 30	16	15 17	16	30 45	16	45 54	15	17
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44	27 32	16	43 56	16	18 0 2	16	15 48	16	31 16	15	46 24	14	15
45	27 48	17	44 12	16	18 0 18	16	16 4	16	31 31	15	46 38	15	14
46	28 5	16	44 28	17	0 34	16	16 20	15	31 46	16	46 53	15	13
47	28 21	17	44 45	16	0 50	15	16 35	16	32 2	15	47 8	15	12
48	28 38	16	45 1	16	1 5	16	16 51	15	32 17	15	47 23	15	11
49	28 54	17	45 17	16	1 21	16	17 9	16	32 32	15	47 38	15	10
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54	30 17	16	46 38	16	2 41	16	18 24	16	33 48	16	48 53	15	5
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57	31 6	17	47 27	16	3 28	16	19 11	15	34 34	15	49 38	14	2
58	31 23	16	47 43	16	3 44	16	19 27	15	34 49	15	49 52	15	1
59	31 39	17	47 59	16	4 0	16	19 42	16	35 5	14	50 7	15	0
	11		10		9		8		7		6		

	24	di	25	di	26	di	27	di	28	di	29	di	
	Mgr,mi,sec	s.	gr. mi. s.	s.	gr.mi.se.	s.	gr.mi.sec	s.	gr.m. se	s.	gr.mi.se	s.	M
0	18 50 22	15	19 5 5	14	19 19 26	15	19 33 27	14	19 47 7	14	20 0 26	13	59
1	18 50 37	15	19 5 15	15	19 19 41	14	19 33 41	14	19 47 21	13	20 0 39	13	58
2	50 52	15	5 34	14	19 55	14	33 55	14	47 34	14	0 52	13	57
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4	51 22	15	6 3	15	20 23	14	34 23	14	48 1	14	1 18	13	55
5	51 37	14	6 17	15	20 37	14	34 37	13	48 15	13	1 31	13	54
6	51 51	15	6 32	14	20 51	15	34 52	14	48 28	14	1 44	13	53
7	52 6	15	6 46	15	21 6	14	35 4	14	48 42	13	1 58	13	52
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9	52 36	15	7 15	15	21 34	14	35 32	14	49 8	14	2 24	13	50
10	52 51	15	7 30	14	21 48	14	35 46	13	49 22	13	2 37	13	49
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12	53 20	15	7 59	14	22 16	14	36 13	14	49 49	13	3 3	13	47
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14	53 50	15	8 27	15	22 44	15	36 41	13	50 16	13	3 29	13	45
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16	54 20	14	8 56	15	23 13	14	37 8	14	50 42	14	3 55	13	43
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18	54 49	15	9 25	15	24 41	14	37 36	13	51 9	14	4 21	13	41
19	55 4	15	9 40	14	24 55	14	37 49	14	51 23	13	4 34	13	40
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21	55 33	15	10 9	14	24 23	14	38 17	14	51 49	14	5 0	13	38
22	55 48	15	10 23	14	24 37	14	38 31	13	52 3	13	5 13	13	37
23	56 3	15	10 37	15	24 51	14	38 44	14	52 16	13	5 26	13	36
24	56 18	14	10 52	14	25 5	14	38 58	14	52 29	14	5 39	13	35
25	56 32	15	11 6	15	25 19	14	39 12	13	52 43	13	5 52	13	34
26	56 47	15	11 21	14	25 33	14	39 25	14	52 56	13	6 5	13	33
27	57 2	15	11 35	14	25 47	14	39 39	14	53 9	14	6 18	13	32
28	57 17	14	11 49	15	26 1	14	39 53	13	53 23	13	6 31	13	31
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30	57 46	15	12 18	14	26 30	14	40 20	14	53 49	14	6 57	13	29
31	58 1	14	12 32	15	26 44	14	40 34	13	54 3	13	7 10	13	28
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36	59 14	15	13 44	14	27 54	13	41 42	14	55 9	13	8 14	13	23
37	59 29	14	13 58	15	28 7	14	41 56	13	55 22	14	8 27	13	22
38	59 43	15	14 13	14	28 21	14	42 9	14	55 36	13	8 40	13	21
39	59 58	15	14 27	14	28 35	14	42 23	13	55 49	13	8 53	13	20
40	19 0 13	14	14 41	15	28 49	14	42 36	14	56 2	13	9 6	13	19
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42	0 42	25	15 10	14	29 17	14	43 4	13	56 29	13	9 32	13	17
43	0 57	14	15 24	15	29 31	14	43 17	14	56 42	13	9 45	12	16
44	1 11	15	15 39	14	29 45	14	43 31	13	56 55	13	9 57	13	15
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48	2 10	14	16 36	14	30 41	14	44 25	14	57 48	13	10 49	13	11
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56	4 6	15	18 30	14	32 32	14	46 13	14	59 33	13	12 31	13	3
57	4 21	14	18 44	14	32 46	14	46 27	13	59 46	14	12 44	13	2
58	4 35	15	18 58	14	33 0	14	46 40	14	20 0 0	13	12 57	13	1
59	4 50	51	19 12	14	33 14	13	46 54	13	20 0 13	13	13 10	12	0
	5		4		3		2		1.		0		

M	0 gr.	0 mi.	0 se.	di f.	1 gr.	1 mi.	1 se.	di f.	2 gr.	2 mi.	2 se.	di f.	3 gr.	3 mi.	3 se.	di f.	4 gr.	4 mi.	4 sec	di f.	5 gr.	5 mi.	5 se	di f.	M
0	20	13	22	13	20	25	57	12	20	38	9	12	20	49	59	11	21	1	25	11	21	12	28	11	59
1	20	13	35	13	20	26	9	13	20	38	21	12	20	50	10	12	21	1	36	12	21	12	39	11	58
2	20	13	48	13	20	26	22	12	20	38	33	12		50	22	11		1	48	11		12	50	11	57
3	20	14	1	12	20	26	34	13	20	38	45	12		50	33	11		1	59	11		13	1	11	56
4	20	14	13	13	20	26	47	12	20	38	57	12		50	45	12		2	10	11		13	12	10	55
5	20	14	26	13	20	26	59	12		39	9	12		50	57	11		2	21	11		13	22	11	54
6	20	14	39	13	20	27	11	13		39	21	12		51	8	12		2	32	12		13	33	11	53
7	20	14	52	12	20	27	24	12		39	33	12		51	20	11		2	44	11		13	44	11	52
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9	20	15	17	13	20	27	48	13		39	57	12		51	43	12		3	6	11		14	6	10	50
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18	20	17	11	13	20	29	39	12		41	48	12		53	27	11		4	46	12		15	43	10	41
19	20	17	24	12	20	29	51	13		41	56	12		53	38	12		4	58	11		15	53	11	40
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21	20	17	49	13	20	30	16	12		42	20	12		54	1	12		5	20	11		16	15	10	38
22	20	18	2	12	20	30	28	12		42	32	12		54	13	11		5	31	11		16	25	11	37
23	20	18	14	13	20	30	40	13		42	44	12		54	24	12		5	42	11		16	36	11	36
24	20	18	27	13	20	30	53	12		42	56	12		54	36	11		5	53	11		16	47	11	35
25	20	18	40	12	20	31	5	12		43	8	12		54	47	12		6	4	11		16	58	10	34
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28	20	19	17	13	20	31	41	13		43	43	12		55	22	11		6	37	11		17	30	10	31
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36	20	20	58	12	20	33	19	12		45	18	11		56	53	12		8	6	11		18	55	10	23
37	20	21	10	13	20	33	31	12		45	29	12		57	5	11		8	17	11		19	5	11	22
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	6	di	7	di	8	di	9	di	10	di	11	di	
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m	12	di	13	di	14	di	15	di	16	di	17	di	m
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m	18 gr.	mi	ſ	di ſe.	19 gr.	mi.	ſe	ſ.	di	20 gr.	mi	ſe.	ſ	di	21 gr.	mi.	ſe.	ſe	di	22 gr.	mi.	ſe	ſ.	di	23 gr.	mi.	ſe	ſe.	m
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39	23	2	17	5	23	7	11	5		23	11	39	4		23	15	39	4		23	19	13	3			22	19	3	20
40	23	2	22	5	23	7	16	5		23	11	43	4		23	15	43	4		23	19	16	3		23	22	22	3	19
41	23	2	27	5	23	7	21	4		23	11	47	4		23	15	47	3		23	19	19	4			22	25	3	18
42	23	2	32	6	23	7	25	5		23	11	51	4		23	15	50	4		23	19	23	3			22	28	3	17
43	23	2	38	5	23	7	30	4		23	11	55	5		23	15	54	4		23	19	26	3			22	31	3	16
44	23	2	43	5	23	7	34	5		23	12	0	4		23	15	58	4		23	19	29	4			22	34	3	15
45	23	2	48	5	23	7	39	5		23	12	4	4		23	16	2	5		23	19	33	3		23	22	37	2	14
46	23	2	53	5	23	7	44	4		23	12	8	4		23	16	5	4		23	19	36	3			22	39	3	13
47	23	2	58	5	23	7	48	5		23	12	12	4		23	16	9	4		23	19	39	3			22	42	3	12
48	23	3	3	5	23	7	53	5		23	12	16	4		23	16	13	4		23	19	42	4			22	45	3	11
49	23	3	8	5	23	7	58	4		23	12	20	5		23	16	17	3		23	19	46	3			22	48	3	10
50	23	3	13	5	23	8	2	5		23	12	25	4		23	16	20	4		23	19	49	3		23	22	51	2	9
51	23	3	18	5	23	8	7	4		23	12	29	4		23	16	24	4		23	19	52	4			22	53	3	8
52	23	3	23	5	23	8	11	5		23	12	33	4		23	16	28	3		23	19	56	3			22	56	3	7
53	23	3	28	5	23	8	16	4		23	12	37	4		23	16	31	4		23	19	59	3			22	59	3	6
54	23	3	33	5	23	8	20	5		23	12	41	4		23	16	35	4		23	20	2	3			23	2	3	5
55	23	3	38	5	23	8	25	5		23	12	45	4		23	16	39	3		23	20	5	3		23	23	5	2	4
56	23	3	43	5	23	8	30	4		23	12	49	5		23	16	42	4		23	20	8	4			23	7	3	3
57	23	3	48	5	23	8	34	5		23	12	54	4		23	16	46	4		23	20	12	3			23	10	3	2
58	23	3	53	5	23	8	39	4		23	12	58	4		23	16	50	3		23	20	15	3			23	13	3	1
59	22	3	58	5	23	8	43	5		23	13	2	4		23	16	53	4		23	20	18	3			23	16	3	0
		11				10					9					8					7					6			

m	24 gr.	mi	sec	di se.	25 gr.	mi.	s.	di s.	26 gr.	mi.	s.	di s.	27 gr.	mi	s.	di se	28 gr.	mi.	se.	th.	di th	29 gr.	mi.	se.	th.	di th	m
0	23	23	18	3	23	25	48	3	23	27	51	2	23	29	27	1	23	30	35	16	53	23	31	16	17	55	59
1		23	21	3		25	51	2		27	53	2		29	28	1		30	36	9	54	23	31	16	44	27	58
2		23	24	3		25	53	2		27	55	2		29	29	2		30	37	3	54	23	31	17	11	26	57
3		23	27	2		25	55	2		27	57	2		29	31	1		30	37	57	54	23	31	17	37	26	56
4		23	29	3		25	57	2		27	59	1		29	32	1		30	38	51	51	23	31	18	3	25	55
5	23	23	32	3	23	26	0	2	23	28	0	2	23	29	33	1	23	30	39	42	52	23	31	18	28	25	54
6		23	35	2		26	2	2		28	2	2		29	34	2		30	40	34	52	23	31	18	53	24	53
7		23	37	3		26	4	2		28	4	2		29	36	1		30	41	26	52	23	31	19	17	24	52
8		23	40	2		26	6	3		28	6	1		29	37	1		30	42	18	50	23	31	19	41	24	51
9		23	42	3		26	9	2		28	7	2		29	38	2		30	43	8	50	23	31	20	5	23	50
10	23	23	45	3	23	26	11	2	23	28	9	2	23	29	40	1	23	30	43	58	50	23	31	20	28	22	49
11		23	48	3		26	13	2		28	11	2		29	41	1		30	44	48	51	23	31	20	50	22	48
12		23	51	2		26	15	2		28	13	1		29	42	2		30	45	39	49	23	31	21	12	22	47
13		23	53	3		26	17	3		28	14	2		29	44	1		30	46	28	48	23	31	21	34	21	46
14		23	56	2		26	20	2		28	16	2		29	45	1		30	47	16	48	23	31	21	55	21	45
15	23	23	58	3	23	26	22	2	23	28	18	2	23	29	46	1	23	30	48	4	48	23	31	22	16	21	44
16		24	1	3		26	24	2		28	20	1		29	47	2		30	48	52	47	23	31	22	37	19	43
17		24	4	2		26	26	2		28	21	2		29	49	1		30	49	39	47	23	31	22	56	20	42
18		24	6	3		26	28	2		28	23	2		29	50	1		30	50	26	46	23	31	23	16	19	41
19		24	9	2		26	30	2		28	25	1		29	51	1		30	51	12	46	23	31	23	35	18	40
20	23	24	11	3	23	26	32	3	23	28	26	2	23	29	52	1	23	30	51	58	44	23	31	23	53	18	39
21		24	14	3		26	35	2		28	28	2		29	53	2		30	52	42	45	23	31	24	11	18	38
22		24	17	2		26	37	2		28	30	1		29	55	1		30	53	27	45	23	31	24	29	17	37
23		24	19	3		26	39	2		28	31	2		29	56	1		30	54	12	45	23	31	24	46	17	36
24		24	22	2		26	41	2		28	33	1		29	57	1		30	54	57	42	23	31	25	3	16	35
25	23	24	24	3	23	26	43	2	23	28	34	2	23	29	58	1	23	30	55	39	43	23	31	25	19	16	34
26		24	27	2		26	45	2		28	36	2		29	59	2		30	56	22	43	23	31	25	35	15	33
27		24	29	3		26	47	2		28	38	1		30	1	1		30	57	5	43	23	31	25	50	15	32
28		24	32	2		26	49	2		28	39	2		30	2	1		30	57	48	41	23	31	26	5	14	31
29		24	34	3		26	51	2		28	41	2		30	3	1		30	58	29	41	23	31	26	19	14	30
30	23	24	37	2	23	26	53	2	23	28	43	1	23	30	4	1	23	30	59	10	41	23	31	26	33	14	29
31		24	39	3		26	55	2		28	44	2		30	5	1		30	59	51	41	23	31	26	47	13	28
32		24	42	2		26	57	2		28	46	1		30	6	1		31	0	32	40	23	31	27	0	13	27
33		24	44	3		26	59	2		28	47	2		30	7	2		31	1	12	40	23	31	27	12	12	26
34		24	47	2		27	1	2		28	49	1		30	9	1		31	1	52	38	23	31	27	24	12	25
35	23	24	49	3	23	27	3	2	23	28	50	2	23	30	10	1	22	31	2	30	39	23	31	27	36	11	24
36		24	52	2		27	5	2		28	52	1		30	11	1		31	3	9	37	23	31	27	47	11	23
37		24	54	3		27	7	2		28	53	2		30	12	1		31	3	46	38	23	31	27	58	10	22
38		24	57	2		27	9	2		28	55	2		30	13	1		31	4	24	37	23	31	28	8	10	21
39		24	59	2		27	11	2		28	57	1		30	14	1		31	5	1	37	23	31	28	18	10	20
40	23	25	1	3	23	27	13	2	23	28	58	2	23	30	15	1	23	31	5	38	35	23	31	28	28	9	19
41		25	4	2		27	15	2		29	0	1		30	16	1		31	6	13	35		31	28	37	8	18
42		25	6	3		27	17	2		29	1	2		30	17	1		31	6	48	36		31	28	45	8	17
43		25	9	2		27	19	2		29	3	1		30	18	1		31	7	24	37		31	28	53	8	16
44		25	11	2		27	21	2		29	4	2		30	19	1		31	8	1	33		31	29	1	7	15
45	23	25	13	3	23	27	23	2	23	29	6	1	23	30	20	1	23	31	8	34	34	23	31	29	8	6	14
46		25	16	2		27	25	2		29	7	2		30	21	1		31	9	8	34		31	29	14	7	13
47		25	18	3		27	27	2		29	9	1		30	22	1		31	9	42	34		31	29	21	5	12
48		25	21	2		27	29	2		29	10	1		30	23	1		31	10	16	33		31	29	26	6	11
49		25	23	2		27	31	2		29	11	2		30	24	1		31	10	49	32		31	29	32	5	10
50	23	25	25	3	23	27	33	2	23	29	13	1	23	30	25	1	23	31	11	21	31	23	31	29	37	4	9
51		25	28	2		27	35	1		29	14	2		30	26	1		31	11	52	31		31	29	41	4	8
52		25	30	2		27	36	2		29	16	1		30	27	1		31	12	23	31		31	29	45	3	7
53		25	32	3		27	38	2		29	17	2		30	28	1		31	12	54	30		31	29	48	3	6
54		25	35	2		27	40	2		29	19	1		30	29	1		31	13	24	30		31	29	51	3	5
55	23	25	37	2	23	27	42	2	23	29	20	1	23	30	30	1	23	31	13	54	30	23	31	29	54	2	4
56		25	39	3		27	44	2		29	21	2		30	31	1		31	14	24	29		31	29	56	2	3
57		25	42	2		27	46	2		29	23	1		30	32	1		31	14	53	28		31	29	58	1	2
58		25	44	2		27	48	1		29	24	2		30	33	1		31	15	21	28		31	29	59	1	1
59		25	46	2		27	49	2		29	26	1		30	34	1		31	15	49	28		31	30	0	0	0

5 4 3 2 1 0

Cancer. Tau

Chap. XVIII.

The use of the Table of Declination

THis Table of Declination is made so particularly to every min. of the Ecliptick, to avoid tediousnes, in seeking the part proportionall, when you would find out thereby either the Declination of the Sun, his place being first given in degrees and minutes: or else the place of the Sun in the Zodiack; his Declination being first known by Observation, for which cause especially this labour was undertaken, that hereby it might presently appear how well the Ephemerides and Astronomical Tables hitherto published, agree with the truth of the heavens. Wherein many times no smal difference is found, even in the *Prutenick* Tables themselves, (which have been hitherto accounted the most perfect in that kind) disagreeing half a degree and more from the truth, and that in the place of the Sun, whose motion of all others is accounted most simple and regular, and most easie to be found out.

To find out the Declination of the Sun by his place first given, by help of this table doe thus: If the Sun be in *Aries, Taurus, Gemini, Libra, Scorpio, Sagittarie,* seek the Sign and degree of the Sun in the upper margine or head of the Table, and the odd minutes (if there be any) in the first columne towards the left hand: then look where the line proceeding towards the right hand from the minute of the Sun crosseth the columne coming downwards from the degree of the Sun, for there you have the Declination of the Sun. But if the Sun be in *Cancer, Leo Virgo, Capricorn, Aquarie,* or *Pisces,* do contrariwise, that is, seek the signe and degrees of the Sun in the nether margine or foot of the Table, and the minutes (if there be any) in the last columne next the right hand: and following the line of the minute of the Sun towards the left hand: and the column of the degree of the Sun upwards, in the common meeting of that line and columne you shall find the declination of the Sun.

Example of the first: the first of *May* 1609, the place of the Sun is in 20 degrees 45 minutes of *Taurus* according to the Ephemerides of the Sun hereafter following, made agreeable to many exact Observations, taken by a Quadrant of six foot and a quarter semidiameter in the years 1594. 1595. 1596. 1597. Finding therefore *Taurus* and the 20 degree in the upper part of this

this Table, and 45 minutes in the first columne, I have in the common meeting (of the column descending from 20. and of the line proceeding from 45. minutes towards the right hand) 18. degrees, 0. minutes 18. seconds, the Declination of the Sun the same day at noon here at *London*.

Example of the second: The 15. of *August* the same year by the same Ephemerides, the Sun is in 2. degr. 2. minutes of *Virgo*, Therefore I seek *Virgo*, and 2. in the nether part of this Table and 50. minutes in the last columne towards the right hand ascending upwards. Then following the line of 2 minutes leftwards and the column of 2. degrees upwards in the common meeting of the line and columne, I find ten degres, 47. minutes, 19. sec. the declination of the Sun the same day at noon, for the Meridian of *London*.

But the Declination of the Sun being first known (by Observation or otherwise) the place of the Sun shall most easily be found out by this Table, after this manner: Seek the Suns Declination in the Area of the Table: then if the sign wherein the Sun is (which you may for the most part easily know by estimation) be in the head of the Table, ascend upwards to the top of the same columne in which you found the Declination given, for there you shal have the degree of the Sun: follow also the line wherein you find the given Declination towards the left hand till you come to the first columne leftwards, and there you shall have the minute also.

But if the name of the sign wherein the Sun is, be in the nether part of the Table, you must do all things contrariwise, descending from the Declination found in the Area of this Table in the same columne, till you come to the lowest part thereof, where you shall find the degree of the Sun: and proceeding from the Declination towards the right hand in the same line till you come to the last columne, where you shall find the minutes to be adjoyned, that you may have the true place of the Sun.

This way of finding out the place of the Sun by his Declination, first known by Observation, is then of especial use and truth, when the Sun is neer the Equinoctial points; for there, his Declination altereth quickest, increasing or decreasing about 24 min. in 24. houres. But when the Sun is neer either of the Tropicks, the missing of one minute, yea or half a minute in observing the Declination, may cause you err an whole degree and more, in the place of the Sun. He therefore that listeth trie how well the Ephemerides and Astronomical Tables hitherto published agree

with

with the truth of the heavens, had best make Observation when the Sun is in *Pises*, *Aries*, *Virgo*, and *Libra*, where mising one whole minute in Observing the declination, will cause you misse not past two minutes and an half in the true place of the Sun.

When the Sun is neer either of the Equinoctial points, there may sometimes be some smal difficultie in finding out what sign the Sun is in, which may easily be avoided thus: The Meridian Altitude of the Sun increasing (as in Winter and Spring time) if the height of the Sun be lesse then the complement of the Poles elevation, the Sun is in *Pisces*: otherwise in *Aries*. But if the Meridian Altitudes of the Sun be every day lesse then other, (as in Summer and Autumne, and the height of the Sun at noon greater then the height of the Equinoctial, the Sun is in *Virgo*, otherwise in *Libra*.

There may likewise be some doubt in what sign the Sun is, being neer either of the Tropicks, which may be resolved thus: the Sun having South Declination increasing, is in *Sagittarie*: but if the Declination of the Sun be Southerly and decreasing, he is in *Capricorn*. Contrariwise the Declination of the Sun being Northerly and increasing, he is in *Gemini*, if decreasing he is *Cancer*.

Now whether the Declination of the Sun increase or decrease, you may know by comparing the Declinations of two daies together. For if the Declination answerable to the second day be greater, the Declination increaseth: otherwise it decreaseth. If both daies have equal Declination, the first day the Sun is in *Gemini*, the second in *Cancer*, if his Declination be Northerly; if Southerly, the first day he is in *Sagittarie*, the second in *Capricorn*.

An example or two will make all plaine: The eighth day of *April* 1597. the Declination of the Sun was found by Observation to be 10. degrees, 55. minutes, 27. seconds, which I seek out in the Area of this Table: and in the head of the same columne, in which I find the Declination that commeth neerest unto this, that is 10 degr. 55. min. 33. sec. I see 28. degrees of *Aries*, (for in *April*, the Sun cannot be in *Libra*,) and in the same line wherein I found this Declination, in the furthest columne towards the left hand I find 21. minutes, out of which abate 17. seconds, that is the part proportional answerable to 6. sec. which is the excesse of 10, degr, 55. minutes, 33. sec. (the Declination found in the Table) above 10. degr. 55. min 27. sec. (the Declination found by Observation) and there shall remain the true place of the Sun the same year and day 28. degr. 20. min.

min. 43. ſec. of *Aries*. Which *Maginus* following *Copernicus* and the *Prutenical* Tables (as he profeſſeth) maketh to be the 27. degr. 57. minutes of *Aries* almoſt: that is, 24. minutes, leſſe then truth, that equation alſo being abated, which is anſwerable to the difference of Longitude betwixt *London* and *Venice*.

The 11. of *March* the ſame year at *London* (whereby many and diligent Obſervations by large and ſeveral Inſtruments, the height of the Pole is found to be 51 degrees, 32 minutes) the apparent Meridian Altitude of the Sun was exactly Obſerved to be 38 degrees, 49 minutes: but being corrected by the Parallax and Refraction of the Sun, anſwerable to that height, his true height ſhalbe 38 degr. 51 min. 4 ſec. Whereby it appeareth that his true Declination the ſame day at Noon was 0 degr. 23 min, 4 ſec. And that Northerly, becauſe the height of the Sun was greater then the height of the Equinoctial. It is plain therefore that at that time the Sun was entred into *Aries*. But now to know how far he was entred; ſeek out 0 degr. 23 min. 4 ſec. Or the number next to it, which is 0 degr. 23 min. 9 ſec. In the Area of this Table: wherewith you ſhall alſo find in the ſame line in the column next the left hand 58 minutes, and in the top of the column right over this Declination you ſhall have 0 degr. Therefore it is manifeſt that at that time the Sun was in 0 degr. 58 min. of *Aries* almoſt, for there wanteth only 12 ſeconds hereof, that is the Part Proportional anſwerable to the exceſſe of 9. ſec. above 4 ſec. Where *Maginus*, after the *Prutenick* account, maketh it to be in 0 degr. 25 min. of *Aries*; that is, 33 minutes wanting of the truth found by Obſervation.

The like difference I have often found by many and diligent Obſervations, eſpecially for the ſpace of the four years before mentioned: the whole Catalogue of which Obſervations I thought good (for thy further ſatisfaction herein) to ſet down in a Table, (after I have firſt ſhewed with what Inſtrument, and after what manner I Obſerved the ſame) that if any error herein hath been committed, it may the more eaſily appeare, and be amended.

CHAP. XIX.

The description and use of a great Quadrant, for Observation of the Sun on Land.

THe Instrument therefore wherewith I took those Observations was a Quadrant of more then six foot and a quarter semidiameter, (for the room wherein I was to use it, could not well admit a greater quantity) which by reason of his largeness was so exactly made and divided, that both minutes and half minutes might therein be easily discerned. The Limb and sides of the Quadrant were about two inches and a quarter in thickness; the breadth of the Limb about four inches: the breadth of the Sides about two inches and an half.

In the midst of the ends of one side of this Quadrant were two round holes made, in either end one: whereby the Quadrant was hanged (like a gate on his hinges, upon two round pins, fitted to those holes, and fixed in the ends of a copple of sockets, put close upon a strong square post, Perpendicularly erected, and the upper end thereof fastned to the side of a principal rafter in an upper chamber, where a window (according to the Reclination of the Roof of the house) was made between it and the next rafter, in such sort, that carrying your eye along by the circumference of the Quadrant, you might by the Center thereof placed at the window; see any part of the Heavens neer the Meridian, from the Zenith to the Horizon. The nether end of this post resting on the floor was put into the midst of a socket nailed to the floor, which was so wide, that on every side the post, wedges might be put in to coyn it at pleasure this way or that way, till the side of the Quadrant were found to stand exactly Perpendicular, by the hanging of the plum-line all alongst most precisely upon a line Parallel to the Zenith line of the Quadrant. To the Center of the Quadrant was fastned a strong Ruler, of one inch in thickness, two inches in breadth, and almost six foot and an half in length, carrying two Sights upon it (*viz.* at either end one) of equal breadth and length, the end of the middle line of each Sight falling Perpendicularly upon the middle or fiducial line and plain Superficies of the Ruler. Through the upper Sight placed at the Center, was made a square hole as great as it could well be. Through the midst of this Sight and hole was put a straight wyre, erected Perpendicularly from the Fiducial line

line and plain of the Ruler, and so much of it made flat and thin, as was between the top and base of that square hole. This wyer served for Observing the Stars, the flat side whereof was to be turned towards the eye in Observing of great Stars, and the narrow side or edge of it was turned to the eye-ward when small Stars were to be Observed. Through the midst of the nether Sight (from the top of it to the Base thereof) was made a narrow slit Perpendicularly erected likewise from the Fiducial line and plain of the Ruler and Quadrant. When I Observed the Stars, I looked through this slit, Elevating and Depressing the Ruler, till the wyer (being first fitted to bigness of the Star) did even cover the Star from my sight: in such sort, that I might see both edges of the Star alike on either side above and beneath the wyre. The square hole in the Sight had a cover fitted to it like the cover of a box; wherewith it was wholly covered when the Sun was to be Observed. The nether end of the Ruler carrying the Sights, was to be fastned with a screw-pin, at any part of the Circumference of the Quadrant as need required.

With this Quadrant (alwaies rectified by the Plumb line in time of Observation, as before is shewed) the height of the Sun was most easily and exactly Observed, by turning the Quadrant this way or that away, and Elevating or depressing the Ruler carrying the Sights, till the top and sides of the shadow of the Upper Sight, placed at the center fell upon the nether Sight placed at the center fell upon the nether Sight placed at the Circumference, equidistantly from the top and sides thereof; For then the upper edge of the Ruler sheweth precisely the height of the Sun desired in degrees and minutes upon the limb of the Quadrant: saving that one whole degree was alwaies to be added thereto, because the breadth of that part of the Ruler that lay upon the Limb of the Quadrant was made to be just equal to two degrees: that is on either side one degree from the fiducial line.

Now for finding out the Meridian Altitudes of the Sun and Stars, I first found the Meridian line thus: with the quadrant rectified and used, as before is shewed, I Observed the height of the Sun in the forenoon; and so warily letting the Quadrant stand immoveable, and laying the side of a straight Ruler (that was about seven foot in length) close along to the perpendicular side of the Quadrant: close by the end of that side of the Ruler (touching the floor of the chamber, I made a prick upon the floor: Also laying the side of the Ruler to the perpendicular side,

and limb of the Quadrant, I made in like manner another prick (so far as conveniently I could from the former) upon the floor, close by the corner of that side of the Ruler.

By these two pricks, I drew a right line which represented the intersection of the Suns Azimuth, or of the continued plain of the Quadrant, and of the plain of the floor, in the time of Observation. Likewise in the afternoon (the Ruler of the Quadrant carrying the Sights, being fixed in the same place, where it was in time of Observation in the forenoon) I Observed diligently till the Sun came to the same height that he had when I Observed in the forenoon, which I did by following the motion of the Suns shadow with the Quadrant, till the edges of the top and sides of the shadow of the upper Sight fell upon the nether Sight, equidistantly from the top and sides thereof.

Then carefully letting the quadrant stand immovable, and drawing the line of intersection of the floor, and Suns Azimuth, in time of the afternoon Observation, in like manner as I did in the forenoon, setting one foot of the Compasses in the intersection of those two lines, with the other, drawing an arch, so great as I could between the same lines, and finding out the midst of this arch, a line from the Center drawn by this midst, was the Meridian line: over which, with help of a long Ruler laid to the upright Side, and Limb of the Quadrant, and extended to the floor, (as before) I alwaies placed and fastned the plain of the Quadrant (understood to be continued to the floor) so oft as I Observed the Meridian Altitudes of the Sun or Stars.

Notwithstanding there is some little error in finding the Meridian after this manner, except it be when the Sun is in, or so neer one of the Tropical points, that there can be no sensible alteration of his Declination between the times of the forenoon and afternoon Observations. But the consequents of this error in Observing Meridian Altitudes, may for their smalness justly be neglected and easily avoided if you attend your Observation, but a little before and after the Sun or Stars to be Observed, come upon the Meridian thus found. And for the more certaintie, I took three Observations in the forenoon, and as many in the afternoon, and so found out three Meridian lines, all Parallels each to other, without notable difference; which if it should have chanced to be any, the middlemost Meridian should be like to be the truest.

A Table of OBSERVATIONS

Of the Meridian Altitudes of the Sun, taken by a large *Quadrant*, of more then six foot Semidiameter, in the years 1594, 1595, 1596, 1597, at *London*, where the Elevation of the Pole was by the same Quadrant, and otherwise also exactly observed and found to be 51 degr. 32 min.

1594 *May.*	*The Suns apparent height.*			*The Suns true height.*			*The Suns apparent declination.*		
Day.	*Degr.*	*Min.*	*Sec.*	*Degr.*	*Min.*	*Sec*	*Degr.*	*Min.*	*Sec.*
9 Thurſd.	58	14		58	15	36	19	46	0
11 Satur.	58	41		58	42	33	20	13	0
13 Mund.	59	4		59	5	33	20	36	0
14 Tueſd.	59	15		59	16	33	20	47	0
17 Frid.	59	45		59	46	30	21	17	0
26 Sund.	61	1	30	61	2	58	22	33	30
27 Mund.	61	8		61	9	28	22	40	0
28 Tueſd.	61	14		61	15	28	22	46	0
29 Wedneſ.	61	20	30	61	21	58	22	52	30
31 Frid.	61	31		61	32	25	23	3	0
Iune									
1 Satur d.	61	35		61	36	25	23	7	0
2 Sund	61	40		61	41	25	23	12	0
4 Tueſd.	61	46	30	61	47	55	23	18	30
6 Thurſ.	61	52	30	61	53	55	23	24	30
7 Frid.	61	54		61	55	25	23	26	0
8 Saturd.	61	55	30	61	56	55	23	27	30
9 Sund.	61	56	30	61	57	55	23	28	30
10 Mund	61	57		61	58	25	23	29	0
11 Tueſd.	61	58		61	59	25	23	30	0
12 Wedneſ	61	58		61	59	25	23	30	0
13 Thurſd	61	57	30	61	58	55	23	29	30
14 Frid.	61	57		61	58	25	23	29	0
15 Saturd.	61	56		61	57	25	23	28	0
22 Sat urd	61	35		61	36	25	23	7	0
23 Sund.	61	32		61	33	25	23	4	0
24 Mund.	61	26	30	61	27	58	22	58	30
Iuly									
6 Saturd.	59	56	00	59	57	30	21	28	0
8 Mund.	59	36	30	59	38	00	21	8	30
9 Tueſd.	59	26	0	59	27	33	20	58	0
15 Mond.	58	14	0	58	15	34	19	46	0
16 Tueſd.	58	1	0	58	2	36	19	33	0

The Sun's true declination.			The Sun's place by observation.			The Sun's place by Prutenick Tables.			The difference.	
Degr.	Min.	Sec.	Degr.	Min.	Sec.	Degr.	Min.	Sec.	Min.	Sec.
19	47	36	28 ♊	2	0	27 ♊	43	0	19	0
20	14	33	♊	5	30	29	39	0	26	30
20	37	33	1	57	0	1 ♋	34	0	23	0
20	48	33	2	52	40	2	32	0	20	40
21	18	30	5	33	40	5	25	0	8	40
22	34	58	14	10	30	14	2	0	8	30
22	41	28	15	7	0	15	0	0	7	0
22	47	28	16	3	0	15	57	0	6	0
22	53	58	17	7	30	16	55	0	12	30
23	4	25	19	4	30	18	50	0	14	30
23	8	25	19	55	0	19	47	0	8	0
23	13	25	21	5	0	20	44	0	21	0
23	49	55	22	52	0	22	39	0	13	0
23	25	55	25	3	0	24	34	0	29	0
23	27	25	25	46	0	25	31	0	15	0
23	28	25	26	19	0	26	29	0	10	0
23	29	55	27	22	0	27	26	0	4	0
23	30	25	27	50	0	28	23	0	33	0
23	31	25	29	24	0	29	21	0	3	0
23	31	25	0 ♋	35	0	0 ♋	18	0	17	0
23	30	55	1	36	0	1	15	0	21	0
23	30	25	2	10	0	2	12	0	2	0
23	29	25	3	1	30	3	10	0	8	30
23	8	25	10	5	0	9	51	0	46	0
23	5	25	10	43	0	10	48	0	5	0
22	59	58	11	47	30	11	45	0	2	0
21	29	30	23	23	0	23	13	0	10	0
21	10	0	25	13	40	25	8	0	5	40
20	59	33	26	10	0	26	5	0	5	0
19	47	34	1 ♌	58	0	1 ♌	50	0	8	0
19	34	36	2	55	0	2	47	0	11	0

1594 Iuly.	The Suns Apparent height.			The Suns True height			The Suns apparent Declination.		
Day.	Deg.	Min.	Sec.	Deg.	Min.	Sec.	Degr.	Min.	Sec.
19 Frid.	57	20	0	57	21	39	18	52	0
25 Thurſd.	55	50	0	55	51	41	17	22	0
31 Wedneſ.	54	9	30	54	11	11	15	41	30
Auguſt.									
3 Saturd.	53	15	30	53	17	18	14	47	30
6 Tueſd.	52	19	30	52	21	21	13	51	30
7 Wedneſ.	52	0	0	52	1	51	13	32	0
8 Thurſ.	51	40	30	51	42	21	13	12	30
9 Frid.	51	21	30	51	23	24	12	53	30
12 Mond.	50	23	0	50	24	54	11	55	0
15 Thurſd.	49	21	0	49	22	58	10	53	0
19 Mond.	47	57	0	47	47	59	9	29	0
23 Frid.	46	30	0	46	32	2	8	2	0
24 Satur.	46	7	30	46	9	35	7	39	30
26 Mond.	45	23	30	45	25	32	6	55	30
29 Thurſd.	44	16	0	44	18	4	5	48	0
September.									
16 Mond.	37	18	0	37	19	58	1	10	0
17 Tueſd.	36	54	0	36	55	58	1	34	0
19 Thurſd.	36	7	0	36	8	55	2	21	0
20 Frid.	35	44	0	35	45	55	2	44	0
October.									
1 Tueſday.	31	28	0	31	29	19	7	0	0
3 Thurſd.	30	43	30	30	44	49	7	44	30
4 Friday.	30	21	0	30	22	11	8	7	0
5 Saturd.	29	58	30	29	59	41	8	29	30
16 Wedneſ.	26	0	30	26	0	58	12	27	30
18 Friday.	25	20	30	25	20	44	13	7	30
19 Saturd.	25	0	0	25	0	14	13	28	0
21 Mond.	24	20	0	24	19	45	14	8	0
25 Friday.	23	5	0	23	4	16	15	23	0
29 Tueſd.	21	52	0	21	50	48	16	36	0

The Suns true declination.			The Suns place by Observation.			The Suns place by Prutenick Tables			The difference.	
Degr.	Min.	Sec.	Degr.	Min.	Sec	Degr.	Min.	Sec.	Min.	Sec.
18	53	39	5 ♌	47	45	5 ♌	39	0	8	45
17	23	41	11	29	52	11	25	0	4	52
15	43	11	17	15	6	17	10	0	5	6
14	49	18	20	8	30	20	3	0	5	30
13	53	21	23	2	0	22	57	0	5	0
13	33	51	24	1	0	23	54	0	7	0
13	14	21	24	59	0	24	52	0	7	0
12	55	24	25	55	20	25	50	0	5	20
11	56	54	28	45	24	28	44	0	1	24
10	54	58	1 ♍	40	36	1 ♍	38	0	2	36
9	19	59	6	1	40	5	30	0	31	40
8	4	2	9	25	0	9	22	0	3	0
7	41	35	10	24	15	10	21	0	3	15
6	57	32	12	19	45	12	17	0	2	45
5	50	4	15	14	45	15	12	0	2	45
1	8	2	2 ♎	50	30	2 ♎	48	0	2	0
1	32	2	3	50	42	3	47	0	2	42
2	19	5	5	49	0	5	45	0	2	0
2	42	5	6	46	52	6	44	0	2	52
6	58	41	17	43	13	17	35	0	6	13
7	43	11	19	40	0	19	34	0	6	0
8	5	4	20	39	48	20	33	0	6	48
8	28	19	21	39	36	21	33	0	6	36
12	27	2	2 ♏	40	36	2 ♏	30	0	10	0
13	7	16	4	42	42	4	30	0	12	42
13	27	46	5	40	51	5	30	0	10	51
14	8	15	7	43	45	7	30	0	13	45
15	23	44	11	41	30	11	30	0	11	30
16	37	12	15	46	20	15	31	0	14	20

1594 November.	The Suns Apparent heights.			The Suns True height			The suns apparent Declination.		
Day.	Degr.	Min.	Sec.	Degr.	Min.	Sec.	Degr.	Min.	Sec.
1 Friday.	21	0	0	20	58	19	17	28	0
3 Sund.	20	27	0	20	24	50	18	1	0
4 Mund.	20	12	0	20	9	50	18	16	0
7 Thurſd.	19	27	0	19	24	20	19	1	0
10 Sund.	18	43	0	18	40	20	19	45	0
19 Tueſd.	16	55	0	16	51	22	21	33	0
20 Wedneſ.	16	45	0	16	41	22	21	43	0
22 Friday.	16	27	0	16	22	53	22	1	0
23 Saturd.	16	18	0	16	13	53	22	10	0
27 Wedneſ.	15	48	0	15	43	53	22	40	0
28 Thurſd.	15	41	0	15	36	53	22	47	0
29 Friday.	15	35	0	15	30	53	22	53	0
December.									
17 Tueſd.	15	6	0	15	1	24	23	22	0
18 Wedneſ.	15	9	0	15	4	24	23	19	0
20 Friday.	15	16	0	15	11	24	23	12	0
22 Sunday.	15	25	0	15	20	24	23	3	0
29 Sunday.	16	10	30	16	6	23	22	17	30
January.									
9 Thurſd.	18	4	30	18	1	21	20	23	30
18 Saturd,	30	13	0	20	10	50	18	15	0
23 Thurſd.	21	35	0	21	33	48	16	53	0
26 Sunday.	22	28	30	22	27	18	15	59	30
31 Friday.	24	3	0	24	2	45	14	25	0
February.									
1 Saturd.	24	22	0	24	21	45	14	6	0
5 Wedneſ.	25	43	0	25	43	28	12	45	0
8 Satur.	26	46	0	26	46	41	11	42	0
13 Thurſd.	28	33	0	28	34	2	9	55	0
15 Saturd.	29	19	0	29	20	2	9	9	0
16 Sund.	29	40	30	29	41	41	8	47	30
17 Mond.	30	3	0	30	4	11	8	25	0
20 Thurſd	31	11	30	31	12	49	7	16	30

The Suns true declination.			The Suns place by Observation.			The Suns place by Prutenick Tables			The difference.	
Degr.	Min.	Sec.	Degr.	Min.	Sec.	Degr.	Min.	Sec.	Min.	Sec.
17	29	41	18	51	48	18	32	0	19	48
18	3	10	20	55	48	20	33	0	22	48
18	18	10	21	53	4	21	33	0	20	4
19	3	40	24	54	12	24	35	0	19	12
19	47	40	28	2	25	27	36	0	26	25
21	36	38	7 ♌	19	30	6 ♌	43	0	36	30
21	46	38	8	21	12	7	43	0	38	12
22	5	7	10	23	6	9	45	0	38	6
22	14	7	11	27	0	10	46	0	41	0
22	44	7	15	31	20	14	49	0	42	20
22	51	7	16	38	30	15	50	0	48	30
22	57	7	17	40	50	16	48	0	52	50
23	26	36	4 ♍	38	30	5 ♍	10	0	31	30
23	23	36	5	53	30	6	11	0	18	30
23	16	36	8	5	45	8	13	0	7	15
23	7	36	10	15	36	10	16	0	0	24
22	21	37	17	37	0	17	23	0	14	0
20	26	39	28	56	40	28	35	0	21	4
18	17	10	8 ♎	10	45	7 ♎	43	0	27	45
16	54	12	13	14	38	12	47	0	27	38
16	0	42	16	17	10	15	50	0	27	10
14	25	15	21	23	48	20	53	0	30	48
14	6	15	22	22	24	21	53	0	29	24
12	44	32	26	27	18	25	56	0	31	18
11	41	19	29	29	54	28	57	0	32	54
9	53	58	4 ♓	29	14	3 ♓	59	0	30	14
9	7	58	6	34	6	5	59	0	35	6
8	46	19	7	32	18	6	59	0	33	18
8	23	49	8	32	23	7	59	0	33	23
7	15	11	11	33	36	11	0	0	33	36

1595. February.	The Suns apparent height.			The Suns True height			The Suns apparent Declination,		
Day.	Degr.	Min.	Sec.	Degr.	Min.	Sec.	Degr.	Min.	Sec.
21 Friday.	31	34	0	31	35	27	6	54	0
27 Thursd.	33	54	0	33	55	44	4	34	0
March.									
1 Saturd.	34	40	0	34	41	52	3	48	0
3 Mond.	35	27	0	35	28	52	3	1	0
12 Wednes.	39	0	0	39	2	4	0	32	0
15 Saturd.	40	10	0	40	12	8	1	42	0
17 Mond.	40	58	0	41	0	7	2	30	0
18 Tuesd.	41	22	0	41	24	7	2	54	0
19 Wednes.	41	45	0	41	47	6	3	17	0
20 Thurs.	42	9	0	42	11	6	3	41	0
21 Friday.	42	31	0	42	33	5	4	3	0
25 Tuesd.	44	4	0	44	6	4	5	36	0
26 Wednes.	44	26	30	44	28	34	5	58	30
27 Thursd.	44	49	0	44	51	2	6	21	0
31 Monday.	46	19	0	46	21	5	7	51	0
April.									
3 Thursd.	47	25	0	47	27	3	8	57	0
7 Monday.	48	51	0	48	52	58	20	23	0
8 Tuesday	49	12	0	49	13	58	10	44	0
14 Monday.	51	14	0	51	15	54	12	46	0
May.									
3 Saturd.	56	47	0	56	48	39	18	19	0
6 Tuesday	57	29	30	57	31	9	19	1	31
14 Wednes.	59	10	0	59	11	33	20	42	0
17 Tuesday.	59	43	30	59	45	0	21	25	30
21 Wednes.	60	21	30	60	23	0	21	53	30
23 Friday.	60	38	0	60	39	28	22	10	0
24 Saturd.	60	46	0	60	47	28	22	18	0
29 Thursd.	61	19	0	61	20	28	22	51	0
Iune.									
7 Saturd.	61	54	0	21	55	25	23	26	0
9 Monday	61	56	30	61	57	55	23	28	30

The Suns true declination			*The Suns Place by observation.*			*The Suns place by Prutenick Tables.*			*The difference*	
Degr.	*Min.*	*Sec.*	*Degr.*	*Min.*	*Sec.*	*Degr.*	*Min.*	*ec.*	*Min.*	*Sec.*
6	52	33	12	32	45	12	0	0	32	45
4	32	16	18	34	3	17	59	0	35	3
3	46	8	20	31	17	19	59	0	32	17
2	59	8	22	30	8	21	58	0	32	8
0	34	4	1 ♈	25	22	0 ♈	55	0	30	22
1	44	8	4	21	5	3	53	0	28	5
2	32	7	6	21	45	5	51	0	30	45
2	56	7	7	22	15	6	50	0	32	15
3	19	6	8	20	18	7	50	0	30	18
3	43	6	9	21	3	8	49	0	32	3
4	5	5	10	16	48	9	48	0	28	48
5	38	4	14	14	23	13	44	0	30	23
6	0	34	15	12	20	14	43	0	29	20
6	23	2	16	10	30	15	42	0	28	30
7	53	5	20	6	5	19	38	0	28	5
8	59	3	23	1	52	22	34	0	27	52
10	24	58	26	56	0	26	28	0	28	0
10	45	58	17	54	16	27	27	0	27	16
12	47	54	3 ♌	42	33	3 ♌	18	0	24	33
18	20	39	22	2	40	21	42	0	20	40
19	3	9	24	52	4	24	36	0	16	4
20	43	33	2 ♊	27	10	2 ♊	17	0	10	10
21	17	0	5	25	12	5	10	0	15	12
21	55	0	9	15	0	9	1	0	14	0
22	11	28	11	7	45	10	56	0	11	45
22	19	28	12	6	38	11	53	0	13	38
22	52	28	16	52	10	16	40	0	12	10
23	27	25	25	46	0	25	17	0	29	0
32	29	55	27	22	0	27	12	0	10	0

1595 June.	The Suns apparent height			The Suns true height.			The Suns apparent Declination.		
Day.	Degr.	Min.	Sec.	Degr	Min.	Sec.	Degr.	Min.	Sec.
21 Saturd.	61	40	30	61	41	55	33	21	30
23 Mond.	61	32	0	61	33	25	23	4	0
26 Thurſd.	61	16	0	61	17	28	22	48	0
July.									
30 Wedneſ.	54	30	0	54	31	45	16	2	0
31 Thurſd.	54	14	0	54	15	46	15	46	0
Auguſt.									
1 Frid.	53	56	0	53	57	46	15	28	0
2 Saturd.	53	37	0	53	38	46	15	9	0
8 Frid.	51	45	0	51	46	51	13	17	0
9 Saturd.	51	26	0	51	27	54	12	58	0
10 Sund.	51	6	0	51	7	54	12	38	0
19 Tuſd.	48	2	0	48	4	0	9	34	0
21 Thurſd.	47	20	0	47	22	3	8	52	0
23 Friday	46	57	30	46	59	33	8	29	30
26 Tueſd.	45	30	0	45	32	4	7	2	0
29 Friday.	44	22	0	44	24	4	5	54	0
September.									
7 Sund.	40	54	0	40	56	7	2	26	0
8 Mond.	40	30	0	40	32	7	2	2	0
9 Tueſd.	40	7	0	40	9	8	1	39	0
10 Wed.	39	44	0	39	46	8	1	16	0
11 Thurſd.	39	20	0	39	22	5	0	52	0
16 Tueſd.	37	23	30	37	25	29	1	4	30
17 Wed.	37	0	0	37	1	58	1	28	0
18 Thurſd.	36	36	0	36	37	58	1	52	0
19 Friday.	36	12	0	36	13	55	2	16	0
20 Saturd.	35	48	30	35	50	23	2	39	30
23 Tueſd.	34	38	0	34	39	52	3	50	0
26 Friday	33	29	0	33	30	39	4	59	0
October.									
2 Thurſd.	31	11	30	31	12	49	7	16	30
3 Friday.	30	48	0	30	49	19	7	40	0

The Suns true declination			*The Suns place by Observation.*			*The Suns place by Prutenick Tables.*			*The difference.*	
Degre.	*Min.*	*Sec*	*Degr.*	*Min.*	*Sec.*	*Degr.*	*Min.*	*Sec.*	*Min.*	*Sec.*
2♑	13	55	8 ♋	47	45	8	39	0	8	45
23	5	25	10	43	15	10	34	0	9	15
22	49	28	13	37	50	13	26	0	11	50
16	3	45	16 ♌	7	0	15 ♌	58	0	9	0
15	47	46	17	0	3	16	0	2	4	3
15	29	46	17	58	57	17	54	0	4	57
15	10	46	19	0	16	18	51	0	9	16
13	18	51	24	45	48	24	38	0	7	48
12	59	54	25	42	6	25	36	0	6	6
12	39	34	26	40	54	26	34	0	6	54
9	36	0	5 ♍	18	14	5 ♍	15	0	3	14
8	54	3	7	11	32	7	12	0	0	28
8	31	33	8	11	46	8	10	0	1	46
7	4	4	12	2	44	12	3	0	0	16
5	56	4	14	59	16	14	58	0	1	16
2	28	7	23	48	18	23	44	0	4	18
2	4	7	24	48	42	24	43	0	5	42
1	41	8	25	46	25	25	41	0	5	25
1	18	8	26	44	10	26	40	0	4	10
0	54	5	27	44	27	27	39	0	5	27
1	2	31	2 ♎	36	40	2 ♎	33	0	3	40
1	26	2	3	35	40	3	32	0	3	40
1	50	2	4	35	35	4	31	0	4	55
2	14	5	5	36	22	5	30	0	6	22
2	37	35	6	35	32	6	29	0	6	32
3	48	8	9	33	52	9	26	0	7	52
4	57	21	12	29	57	12	24	0	5	57
7	15	11	18	26	22	18	20	0	6	22
7	38	41	19	28	5	19	19	0	9	5

1595 October.	The Suns Apparent height.			The Suns True height.			The Suns apparent Declination.		
Day.	Deg.	Min.	Sec.	Degr.	Min.	Sec.	Deg.	Min.	Sec.
9 Thurſd.	28	35	0	28	35	55	9	53	0
11 Saturd.	27	12	0	27	52	54	10	36	0
12 Sund.	27	30	0	27	30	47	10	58	0
15 Wedneſ.	26	26	30	26	27	3	12	1	30
17 Friday.	25	45	0	25	45	25	12	43	0
30 Thurſd.	21	37	30	21	36	8	16	50	30
Novemb.									
18 Tueſd.	17	8	0	17	4	26	21	20	0
19 Wed.	16	58	0	16	54	21	21	30	0
20 Thurſd.	16	48	0	16	44	16	21	40	0
24 Mond.	16	13	30	16	9	30	22	14	30
December.									
2 Tuſd.	15	20	30	15	15	34	23	7	30
10 Wedneſ.	15	0	0	14	55	30	23	28	0
12 Friday.	14	58	0	14	53	23	23	30	0
18 Thurſd.	15	8	0	15	3	28	23	20	0
20 Saturd.	15	14	0	15	9	31	23	14	0
21 Sund.	15	18	0	15	13	33	23	10	0
24 Wed.	1	34	0	15	29	40	22	54	0
30 Tueſd	16	16	0	16	12	0	22	12	0
January.									
1 Thurſd.	16	34	0	16	30	7	21	54	0
3 Saturd.	16	53	0	16	44	18	21	35	0
10 Saturd.	18	14	0	28	18	58	20	14	0
12 Mond.	18	39	30	18	36	40	19	48	30
14 Wedneſ.	19	8	0	19	5	24	19	20	0
22 Thurſd.	21	14	0	21	12	26	17	14	0
24 Wedneſ.	21	48	0	21	16	42	16	40	0
February.									
13 Friday.	28	29	0	28	29	58	9	59	0
17 Tueſd.	29	57	0	29	58	10	8	31	0
18 Wed.	30	10	0	30	11	12	8	18	0
24 Tueſd.	32	37	30	32	39	2	5	50	30

The Suns true declination.			The Suns place by observation.			The Suns place by Prutenick Tables.			The difference.	
Degr.	Min.	Sec.	Degr.	Min.	Sec.	Degr.	Min.	Sec	Min.	Sec.
9	52	1	25	25	27	25	17	0	8	27
10	35	6	27	24	3	27	16	0	8	2
10	57	13	28	25	40	28	16	0	9	40
12	0	57	1 m	26	14	1 m	15	0	11	14
12	42	35	3	26	57	3	15	0	11	57
16	51	52	16	37	14	16	16	0	21	14
21	23	34	6 ♐	2	30	5 ♐	27	0	35	30
21	33	39	7	1	33	6	28	0	33	33
21	43	44	8	3	0	7	28	0	35	0
22	18	30	11	59	22	11	32	0	27	22
23	12	26	20	50	15	16	39	0		
23	32	30				27	47	0		
23	34	37				29	50	0		
23	24	32	5 ♍	32	0	5 ♍	56	0	24	0
23	18	29	7	34	0	7	58	0	24	0
23	14	27	8	39	45	8	59	0	19	15
22	58	20	12	5	50	12	3	0	2	50
22	16	0	18	19	15	18	9	0	10	15
21	57	53	20	26	0	20	11	0	15	0
21	38	42	22	28	0	22	24	0	14	0
20	17	2	29	42	45	29	22	0	20	45
19	51	20	1 ♒	41	13	1 ♒	23	0	18	13
19	22	36	3	46	34	3	25	0	21	34
17	15	34	11	59	4	11	32	0	27	4
16	41	18	13	59	30	13	30	0	29	30
9	58	2	4 ♓	18	6	3 ♓	40	0	38	6
8	29	50	8	16	22	7	44	30	31	52
8	16	48	8	51	3	8	45	0	6	3
5	48	57	15	18	10	14	45	0	33	10

1595 February.	The Suns Apparent height.			The Suns True height			The Suns apparent Declination.		
Day	Degr.	Min.	Sec.	Degr.	Min.	Sec.	Dege.	Min.	Sec.
25 Wed.	33	1	0	33	2	35	5	27	0
26 Thursd.	33	24	0	33	25	39	5	3	0
29 Sund.	34	34	30	34	36	19	3	53	30
March.									
13 Saturd.	39	42	0	39	44	7	1	14	0
14 Sund.	40	6	0	40	8	8	1	38	0
16 Tuesd.	40	52	0	4	54	7	2	24	0
April.									
20 Tuesd.	53	23	0	53	24	46	14	55	0
24 Saturd.	54	35	0	54	36	44	16	7	0
25 Sund.	54	51	30	54	53	13	16	23	30
26 Mond	55	8	30	55	10	13	16	40	0
28 Wed.	55	41	0	55	42	41	17	13	0
10 Thursd	55	57	0	55	58	36	17	29	0
May.									
4 Tuesd	57	13	0	57	14	39	18	45	0
11 Tuesd.	58	45	30	58	47	5	20	17	30
Innd.									
15 Tuesd.	61	54	0	61	55	25	23	26	0
18 Friday.	61	47	0	61	48	25	23	19	0
Iuly.									
24 Saturd.	55	56	0	55	57	41	16	28	30
27 Tuesd.	55	8	0	55	9	43	16	40	0
29 Thursd.	54	34	0	54	35	44	16	6	0
30 Friday	54	17	0	54	18	46	15	49	0
31 Saturd.	54	0	0	54	1	46	15	32	0
Auguſt									
10 Tuesd.	50	51	0	50	52	54	12	23	0
13 Friday	49	50	30	49	52	26	11	22	30
16 Mond.	48	48	0	48	49	58	10	20	0
21 Saturd.	47	1	30	47	3	33	8	33	30
30 Mond.	43	41	0	43	43	4	5	13	0

The Suns true declination			The Suns place by Observation.			The Suns place by Prutenick Tables.			The difference	
Degre.	Min.	Sec	Degr.	Min.	Sec.	Degr.	Min.	Sec.	Min.	Sec.
5	25	25	16	18	8	15	45	0	33	8
5	2	21	17	17	15	16	45	0	32	15
3	51	41	20	17	12	19	45	0	32	12
1	16	7	3 ♈	10	48	2 ♈	39	0	31	48
1	40	8	4	11	2	3	38	0	33	2
2	26	7	6	6	40	5	37	0	29	40
14	56	48	10 ♉	15	13	9 ♉	51	0	24	13
16	8	44	14	9	40	13	44	0	25	40
16	25	13	15	5	20	14	42	0	23	20
16	42	13	16	3	42	15	40	0	23	42
17	14	41	17	57	45	17	36	0	21	45
17	30	36	18	55	10	18	34	0	21	10
18	46	39	23	45	4	23	24	0	21	4
20	19	5	0 ♊	27	0	0 ♊	8	0	19	0
23	27	25	4 ♋	14	0	3 ♋	39	0	35	0
23	20	25	6	58	40	6	31	0	27	40
17	29	41	11 ♌	8	11	10 ♌	56	0	12	11
16	41	43	13	58	3	13	49	0	9	3
16	7	44	15	53	40	15	44	0	9	40
15	50	46	16	50	10	16	42	0	8	10
15	33	46	17	45	3	17	39	0	6	3
12	24	54	27	24	24	27	17	0	7	24
11	24	26	0 ♍	17	48	0 ♍	11	0	6	48
10	21	58	3	12	17	3	5	0	7	17
8	35	33	♎	1	5	7	55	0	6	5
5	15	4	16	44	40	16	40	0	4	40

1596 August.	The Suns apparent height			The Suns true height.			The Suns apparent Declination.		
Day.	Degr.	Min.	Sec.	Degr.	Min.	Sec	Degr.	Min.	Sec.
31 Tuesd.	43	17	30	43	19	35	4	46	30
September.									
5 Sund.	41	22	30	41	24	37	2	54	30
6 Mond.	40	59	0	41	1	7	2	31	0
7 Tuesd.	40	36	0	40	38	7	2	8	0
8 Wed.	40	12	30	40	14	38	1	44	30
13 Mond.	38	16	0	38	18	1	0	12	0
14 Tuesd.	37	52	0	37	54	1	0	36	0
25 Saturd.	33	34	30	33	36	10	4	53	30
27 Mond.	32	48	0	32	49	34	5	40	0
October.									
4 Mond.	30	9	0	30	10	12	8	19	0
November.									
2 Tuesd.	20	35	0	20	33	7	17	53	0
5 Friday.	19	47	30	19	45	14	18	40	30
1597 *January.*									
25 Tuesday.	22	19	0	22	17	57	16	9	0
29 Saturd.	23	34	0	23	33	32	14	54	0
March.									
11 Friday.	38	49	0	38	51	4	0	21	0
12 Saturd.	39	13	0	39	15	4	0	45	0
13 Sund.	39	36	30	39	38	36	1	8	30
14 Monday	40	0	0	40	2	8	1	32	0
15 Tuesd.	40	23	0	40	25	8	1	55	0
16 Wednes.	40	46	30	40	48	37	2	18	30
20 Sund.	42	21	30	42	23	36	3	53	30
21 Mond.	42	44	0	42	46	5	4	16	0
April.									
8 Friday.	49	21	30	49	23	27	10	53	30
30 Saturd.	56	9	0	56	10	41	17	41	0
May.									
2 Mond.	56	40		056	41	40	18	12	0

The Suns true declination			*The Suns place by Observation.*			*The Suns place by Prutenick Tables.*			*The difference.*	
Degr.	*Min.*	*Sec.*	*Degr.*	*Min.*	*Sec.*	*Degr.*	*Min.*	*Sec.*	*Min.*	*Sec*
4	51	35	17	44	47	17	38	30	6	17
2	56	37	22	36	26	22	31	0	5	26
2	33	7	23	35	43	23	30	0	5	43
2	10	7	24	33	40	24	28	0	5	40
1	46	38	25	32	38	25	27	0	5	38
0	9	59	0 ♎	25	0	0 ♎	21	0	4	0
0	33	59	1	25	10	1	19	30	5	40
4	51	50	12	15	52	12	9	0	6	52
5	38	26	14	15	18	14	8	0	7	18
8	17	48	21	11	35	21	3	0	8	35
17	54	53	20 ♍	24	41	20 ♍	3	0	21	41
18	42	46	23	29	30	23	4	0	25	30
16	10	3	15 ♒	45	53	17 ♒	20	0	25	53
14	54	28	19	52	9	19	22	0	30	9
0	23	4	0 ♈	57	48	0 ♈	25	0	32	48
0	47	4	1	57	55	1	25	0	32	55
1	10	36	2	56	58	2	24	0	32	58
1	34	8	3	56	0	3	23	0	33	0
1	57	8	4	53	45	4	23	0	30	45
2	20	37	5	52	50	5	22	0	30	50
3	55	36	9	52	45	9	19	0	33	45
4	18	5	10	49	50	10	18	0	31	50
10	55	27	28	20	43	27	57	0	23	43
17	42	41	19 ♑	39	22	19 ♉	18	0	21	22
18	13	40	21	35	48	21	14	0	21	48

1597. *June.*	*The Suns Apparent height.*			*The Suns True height*			*The Suns apparent Declination.*		
Day	*Degr.*	*Min.*	*Sec*	*Degr.*	*Min*	*Sec.*	*Degr.*	*Min.*	*Sec.*
9 Thurſd	61	57	0	61	58	25	23	29	0
11 Saturd.	61	58	0	61	59	25	23	30	0
12 Sund.	61	58	0	61	59	25	23	30	0
13 Mond.	61	57	30	61	58	55	23	29	30
16 Sund.	61	46	0	61	47	25	23	18	0
July.									
4 Mond.	60	12	30	60	14	0	21	44	30
5 Tueſd.	60	3	30	60	5	0	21	35	30
6 Wed.	59	54	0	59	55	30	21	26	0
8 Friday	59	34	0	59	35	31	21	6	0
24 Sund.	56	1	30	56	3	11	17	33	30
26 Tueſd.	55	30	0	55	31	42	17	2	0
Auguſt									
3 Wed.	53	11	0	53	12	48	14	43	0
9 Tueſd.	51	16	0	51	17	53	12	48	0
September.									
22 Thurſd.	34	50	0	34	51	51	3	38	0
30 Friday	31	44	30	31	45	55	6	43	30
October.									
6 Thurſd	29	29	0	29	30	6	8	59	0
12 Wed.	27	19	0	27	19	45	11	9	0
14 Friday.	26	36	30	26	37	5	11	51	30
24 Mond.	23	16	0	23	15	23	15	12	0
27 Thurſd.	22	22	0	22	20	50	16	6	30
29 Saturd.	21	46	0	21	44	41	16	42	0
November.									
3 Thurſd.	20	24	0	20	22	2	18	4	0
7 Mond.	19	21	30	19	19	0	19	6	30
22 Tueſd	16	24	0	16	20	5	22	4	0

The Suns true declination.			*The Suns place by Observation.*			*The Suns place by Prutenick Tables*			*The difference.*	
Degr.	*Min.*	*Sec.*	*Degr.*	*Min.*	*Sec.*	*Degr.*	*Min.*	*Sec.*	*Min.*	*Sec.*
23	30	25	27 ♊	50	0	27 ♊	41	0	9	0
23	31	25	29	24	0	29	35	0	11	0
23	31	25	0 ♋	36	0	0 ♋	33	0	3	0
23	30	55	1	35	0	1	30	0	5	0
23	19	25	7	17	20	7	14	0	3	20
21	46	0	21	43	0	21	33	0	10	0
21	37	0	22	38	18	22	31	0	7	18
21	27	30	23	34	42	23	28	0	6	42
21	7	31	25	27	11	25	23	0	4	11
17	35	11	10 ♌	48	8	10 ♌	42	0	6	8
17	3	42	12	41	14	12	37	0	4	14
14	44	48	20	22	41	20	18	0	4	41
12	49	53	26	11	36	26	5	0	6	36
3	36	9	9 ♎	3	26	8 ♎	57	0	6	26
6	42	5	16	59	57	16	51	0	8	57
8	57	54	22	58	13	22	48	0	10	13
11	8	15	28	56	34	28	46	0	10	34
11	50	55	0 ♍	57	28	0 ♍	45	0	12	28
15	12	37	11	5	41	10	46	0	19	41
16	17	10	14	4	23	13	46	0	18	23
16	43	19	16	7	30	15	47	0	20	30
8	5	58	21	6	26	20	48	0	18	26
16	9	0	25	16	16	24	50	0	26	16
22	7	55	10 ♐	42	36	10 ♐	1	0	41	36

CHAP. XX.

The finding of the Suns Apogeum *and* Eccentricitie, *out of the former Observations.*

NOw by the whole course of these Observations, it manifestly appeareth, that the Declinations set down in the Regiments of the Sun, that are, and have bin hitherto ordinarily used by our Seamen, do for the most part notably err from the truth of the Heavens. Which errors as they may most truly be corrected by Observation only in those dayes wherein certain Observation was made: so for finding out the Declinations of the middle dayes between the Observations, I thought it the best way, first to make the *Ephemerides* of the Sun hereafter following, agreeable to the former Observations, and then to find out the Declinations answerable to the places of the Sun for every day of four years together, because that after that number of years the same places of the Sun, and the same Declinations return again without sensible error, which also by a certain Equation may be corrected: and for the easier finding out of this Equation, I have continued these Tables for one year more, making them for five years, and so including two Leap years, by the difference of which years we may easily find the said Equation, by means whereof these Tables may be made serviceable for many years.

First therefore for making these *Ephemerides*, it is needful to know the time of the Suns entrance into certain principal points of the Zodiack: as also the time of the Suns continuance in the arches of the Zodiack contained between those points, whereby the proportion of the Suns motion may Geometrically be found out, his Eccentricitie and place of his Apogeum being hereby known.

To know the time of the Suns comming to any point of the Ecliptick.

To know the time of the Suns commnig to any point of the Ecliptick, it is best to Observe exactly the Meridian Altitude of the Sun, not only the same day wherein he is like to enter into the point desired, but every day also, for two or three dayes together, both before and after that day, that both by the testimony of so many Observations compared together, you may have the more assured truth: as also, that if the day you most desire fall not out to be so clear as you would wish, you may notwithstanding, by the Observations of the dayes going before, and following

following after, or either of them, obtain your desire.

Having thus Observed the Meridian Altitudes of the Sun, and thereby also found his Declinations for every one of those dayes wherein you Observed, you shall easily know also the true place of the Sun in every each one of the same dayes, with help of the former Table of the Declination of every minute of the Ecliptick, in such sort as before was declared, when I shewed the use of that Table.

Now if it fall out so happily, that both the day be clear, when the Sun entreth into the desired point of the Ecliptick, and that the place of the Sun answerable to the Declination of that day, be all one with the point desired, you have already that you sought for, without any more ado, *viz.* That the Sun entreth that day at Noon into the point desired. Otherwise subtract the Observed place of the Sun, next before the point desired out of the Observed place of the Sun, next following that point, and the remainder shall shew you the true motion of the Sun, answerable to the time between those Observations. Subtract also the former place of the Sun, from his place in the point desired, and note the difference: for as the former remainder (that is the apparent motion of the Sun between the Observations) is to the time between those Observations: so is this difference to the time between the first Observation, and the Suns entrance into the point desired.

Example of the first: I desired to know the time of the Suns entrance into 17 degrees, 0 min. of ♌ in the year 1595. I Observed therefore (at *London*) the apparent height of the Sun at Noon, the 31 of *July* the same year, and found it to be 54 degrees, 14 minutes, out of which his true height (corrected by his Parallax) was found to be 54 degr. 15 min. 46 sec. Whereby his Declination was gathered to be 15. degrees, 47 minutes, 46 sec. And consequently his place in 17 degrees, 0 minutes of ♌ that day at Noon.

Example of the second: admit the year following 1596. You would know the time of the Suns entrance into the midst of *Taurus*. Having therfore to this end Observed the apparent Meridian Altitudes of the Sun, the 24, 25, and 26. Dayes of *April*, in that year (within the space of which dayes I am sure the Sun must needs be in that point) to be 54 degrees, 35 minutes, 54 degrees, 51 min. $\frac{1}{2}$, 55 degrees, 8 min. $\frac{1}{2}$, and consequently the true heights 54 degr. 36 min. 44 sec. 54 degr. 53 min. 13 sec. 55 degrees, 10 min. 13 sec. And out of these the true Declinations

ons 16 degr. 8 min. 44 sec. 16 degr. 25 min. 13 sec. 16. degr. 52 min. 13. sec. Hereby I found the true places of the Sun the same dayes to be 14 degr. 9 min. 40 sec. Of *Taurus*, 15 degr. 5 min. 20 sec. of *Taurus*, 16 degr. 3 min. 42 sec. Of *Taurus*. Subtracting therefore 14 degr. 9 min 40 sec. Of *Taurus*, (that is, the place of the Sun the 24 day) out of 15 degr. 5 min. 20 sec. of *Taurus*, the place of the Sun the 25 day) the remainder shall be 55 min. 40 sec. Which is the true motion of the Sun, between the 24, and 25. Dayes at Noon, that is, the Diurn motion of the Sun at that time. Subtracting also 14 degr. 9 min. 40 sec. Of *Taurus*, out of 15 degr 0 min. of *Taurus*, the difference is 50 min. 20 sec. Now as 55 min. 40 sec is to 50 min. 20 sec. so are 24 houres, to 21 houres, 42 min. and 2 sec It appeareth therefore by subtracting 21 hours, 42 min. 2 sec. Out of 24 hours, that the Sun should enter into the midst of *Taurus*, the 25 day about two hours and almost 18 min. before Noon, that is, at nine a clock and 42 minutes.

Now supposing I had not, or could not have Observed the 25 day, I may notwithstanding find the time of the Suns entrance into the midst of *Taurus*, by the Observations of the 24 and 26 dayes after this manner: Subtract 14 degr. 9 min. 40 sec. Of *Taurus*, out of 16 degr. 3 min. 42 sec. of *Taurus*, the remainder will be one degr. 54 min. 2 sec. that is the motion of the Sun for two dayes, between the 24 and 26 dayes at Noon. Therefore as 1 degr. 54 min. is to 48 hours: so are 50 min. 20 sec. (That is the Difference of the place of the Sun the 24 day from the midst of *Taurus*, found out as before) to 21 hours and 12. min. almost. So as hereby it seemeth the Sun should enter into the midst of *Taurus* the 25 day about two hours and 48 minutes before Noon, that is, at nine of the clock and 12 minutes.

But if it so fall out that you do not or cannot Observe, both before and after the time of the Suns comming to the point desired, (as suppose I could not have Observed the 24 day, but only the 25 and 26 dayes, in both which dayes the Sun is gone past the point desired) notwithstanding you may Obtain your desire thus: Subtract 15 degr. 5 min. 20 sec, *Taurus*, (the place of the Sun the 25 day) out of 16 degr, 3 min. 42 sec. *Taurus* (the place of the Sun the 26 day) there will remain 58 min. 22 sec. the Diurn motion of the Sun between the Noon-tides of the 25 and 26 dayes. Now because that on the 25 day at Noon the Sun was gone 5 min. 20 sec. past the point desired: therefore as

58

58. min. 20 ſec. Are to 24 hours, ſo are 5 min. 20 ſec. to 2 hours 12 min. almoſt. By this account then the Sun ſhould enter into the midſt of *Taurus* the 25 day, 2 hours and about 12 min. before Noon: that is, at nine of the clock and 48 minutes. Neither ought that ſmal difference that appeareth between theſe accounts to be greatly regarded, which amounts not to ſo much as half an hour, in which time the motion of the Sun is little above a minute, and the Declination of the Sun in that part of the Zodiack cannot alter ſo much as $\frac{1}{3}$ of a minute, which is ſo ſmal, as can by ſenſe very hardly be Obſerved or diſcerned. Neither yet ought that little difference of a minute or two that appeareth between the Diurn motions of the Sun; found by Obſervation, greatly move any man (in that by the firſt and ſecond Obſervations the Diurn motion ſhould be almoſt 56 min. by the firſt and third 57 min. by the ſecond and third 58 min. and more) the greateſt of which differences may almoſt ariſe by erring but one half minute only, in taking the height of the Sun; which error is in a manner altogether inſenſible, and will be eaſily pardoned by them that have or ſhall accuſtom themſelves to make the like Obſervations, when beſides their own experience they ſhall find that they which have moſt excelled in this Art, as *Tycho Brahe de receptioris. Ætherei mundi phænom. lib* 2 *cap.* 10. *part* 1. *Copern. Revol. Libr.* 4. *cap.* 21. and *Ptoleme* himſelf in all his Catalogue of the fixed Stars, *Almageſt. lib.* 7. *cap.* 5. When they ſhall find (I ſay) that even theſe Princes in Aſtronomy, ſo greatly exerciſed in Obſervations, have accounted an whole minute or two, hardly ſenſible: *Ptoleme* alſo in his *Almageſt*. Contenting himſelf, for the moſt part, to have ſet down the places of the fixed Stars to ſixth parts of degrees, and very ſeldom comming to twelfth parts, thinking it ſufficient (as it may ſeem by the perpetual courſe of that Catalogue) to come within five or ten minutes of the truth.

But to return again to that from whence we have a little digreſſed. After this manner now ſhewed we found the time of the Suns entrance into the beginning of ♈ and ♎, and into the midſt of ♉, ♌, ♏, and ♒, as into places ſerving moſt fitly for finding out of the Suns Eccentricitie and *Apogeum*: following alſo herein the example of *Copernicus*, *lib.* 3. *cap.* 16. *Revol.* Who well perceiving how hard, yea rather impoſſible a thing it is, to find by Obſervation the time of the Suns entrance into the Solſtitial points (where the Meridian Altitudes, and Declinations of the Sun continue almoſt the ſame, without any ſenſible difference,

for two or three dayes together) chose rather the parts of the Zodiack already mentioned, where the place of the Sun may more truly be known by reason of the quicker altering of his Declination, the difference thereof in the space of 24 hours amounting to more then 17 min. The times therefore of the Suns comming to the foresaid points in the years 1594, 1595, 1596, 1597. We found to be such as are set down in the Table following.

	1594			1595			1596			1597				
	Da.	*Ho.*	*Mi.*	*Da.*	*Ho.*	*Mi.*	*Da.*	*Ho.*	*Mi.*	*Da.*	*Ho.*	*Mi.*	*Sig.*	*De.*
Ian.				24	17	35	25	0	7	24	5	54	♒	15
Mar.				10	13	26	9	18	43	10	0	37	♈	0
April.				25	16	50	24	21	47	25	3	54	♉	15
Iuly.	28	15	35	28	20	4	28	1	43	28	9	56	♌	15
Sept.	13	2	45	13	7	39	12	13	48	12	19	15	♎	0
Octob.	28	5	46	28	9	36	27	15	23	272	1	50	♏	15

Hereby the times of the Suns continuance in the arks of the Zodiack betwixt those points, as also the arks of the Eccentrick answerable to those times, were more easily found then that it should now be needfull for me to be further tedious, in setting down the manner of finding the same, wherein notwithstanding there may some difference of an hour or two sometimes appear, by comparing together those times in several years: yet this error being such as may arise by missing little more then one minute in (one Observation: or little more then half a minute in two Observations of the Meridian Altitudes of the Sun, one Observation being made when the Sun is about the beginning of the ark, the other when he is about the ending thereof) I make no doubt, but that it will at the least be favourably censured by them that have acquainted themselves with some practise of Observing: wherein he shall (in my opinion) quit himself meetly well who neither through imperfection of sense, either in making or dividing, or in rectifying, or in using his Instrument, and every part thereof: nor through the difficultie of noting precisely the edges of the shadow of the upper sight falling upon the nether: (the limits or bounds of which shadow are but a confused mixture (as it were) of light and darkness, or else a mean equally compounded of them both, which can no better be discerned then by guessing:) nor yet by Rrefraction of the Sun beams through the thickness of the air; especially when the Sun is in the Southerly

Southerly Semicircle of the Zodiack, which Refraction admitteth ſome alteration, according to the diverſitie of the raritie or denſitie of the Vapours in the air interpoſed betwixt our ſight and the Sun; he ſhall (I ſay) quit himſelf well that neither by one, nor ſome, nor all theſe, ſhall miſſe a minute, and more ſomtimes, in Obſerving the meridian Altitude of the Sun: whereby if error be committed both at the beginning and ending of the aforeſaid arks (eſpecially of thoſe arks that are contained between the midſt of *Taurus*, and *Leo*, of *Leo*, and *Scorpio*, of *Scorpio*, and *Aquarius*, of *Aquarius*, and *Taurus*,) the place of the Sun found by ſuch Obſervation, may be more or leſſe then truth by three or four minutes, and both errors together may amount to ſix or eight min. error in the motion of the Sun, whereof may follow two or three hours error in the time of the Suns abiding in one of thoſe arks.

Out of the former Table I found (by the Obſervations of the two laſt years eſpecially) that the time of the Suns Revolution through the Zodiack in our time, is 365. dayes 5. hours, and about 48. min. Alſo the Suns continuance in the Northerly Semicircle of the Ecliptick, from the beginning of *Aries* to the begining of *Libra*, to be 186. dayes, 18. hours, and about one half, and conſequently in the Southerly Semicircle from *Libra* to *Aries* 178. dayes 11. houres 18. minutes: whereby the arks of the Suns Eccentrick, anſwerable to thoſe Semicircles, appeared to be 184 degrees, 5, min. 25. ſec. from *Aries* to *Libra*, and 175 degrees, 54. min. 35. ſec. from *Libra* to *Aries*.

Therefore becauſe the place of the Sun being at, or neer the Equinoctial points, is moſt certainly known (his Meridian Altitude and Declination altering there moſt ſwiftly) and conſequently the ark of the Eccentrick contained betwixt thoſe points are moſt certainly found: it appeareth to be moſt certain that the Eccentricitie of the Sun at this time muſt needs be at the leaſt 3.569. ſuch parts whereof the Semidiameter of the Eccentrick containeth 100,000. though the Suns Apogeum were but in the beginning of *Cancer*: whereas if it be in 9. degr. 22. min. of *Cancer* (as *Copernicus* would have it) the Eccentricitie cannot be leſſe then 3616. of the ſame parts; notwithſtanding he maketh it to be little more then 3220. ſuch parts in this Age.

But finding by the Obſervations I took in the year 1596. that the Sun is alſo in going from the beginning of *Aries* to the midſt of *Taurus* 46. daies, and about three hours and foure minutes, and conſequently the arch of the Suns Eccentrick, anſwerable to that time and arch of the Ecliptick 45. degr. 27

min. 56. sec. I found hereby, the Suns Eccentricitie and place of his Apogeum, as followeth.

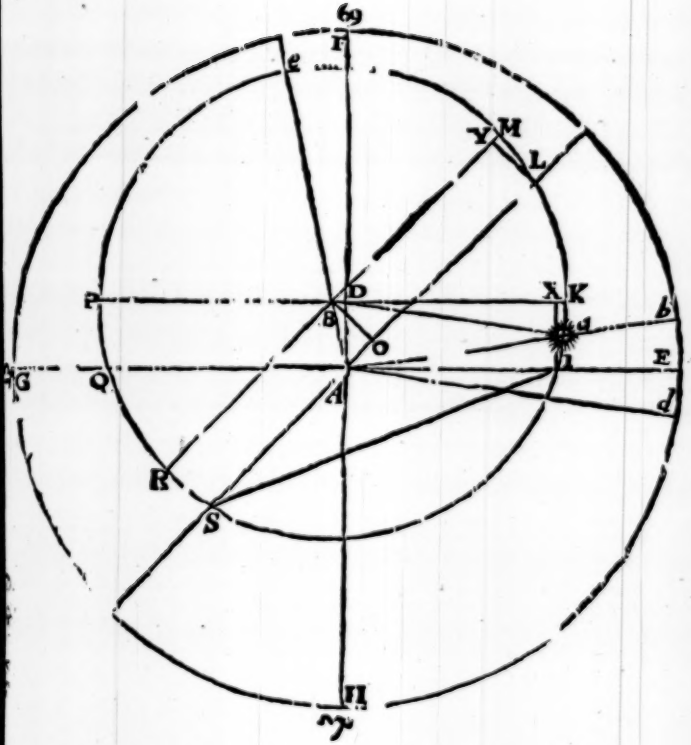
Let I e Q S be the Suns Eccentrick:

	Degr. Mi. Sec.
The arks thereof I E Q from the beginning of *Aries* to the beginning of *Libra*	184 - 5 - 26
Q S I from the Suns entrance into *Libra* to his entrance into *Aries*	175 - 54 - 34
and I L from the beginning of *Aries* to the midst of *Taurus*	45 - 27 - 56
the half whereof is the angle I S L	22 - 43 - 58.
Also the angle I A L from the beginning of *Aries* to the 15 of *Taurus*	45 - 0 - 0
The complement whereof to a Semicircle is the angle I A S	135 - 0 - 0
which added to the angle I S A, makes	157 - 43 - 58
the complement whereof to a Semicircle is the angle A I S	22 - 16 - 2
the double wherof is the arch of the Eccentrick S Q	44 - 32 - 4
which taken out of Q S I	175 - 54 - 34
there remaineth the arch S I	131 - 22 - 30
the subtense whereof S I is	18, 226, 268
whereof the whole sine containeth	10,000, 000
And this arch added to I L, maketh the whole arch S I L	176-50-26
the complement hereof to a Semicircle is	3- 9- 34
and the half of this complement is the arch L M	1 - 34 - 4
the Sine whereof is the line O B	275, 67
Moreover, the half of the arch S I L is	88-25-1
the Sine whereof is the line S A O	9, 996, 19

Now in the Triangle S I A, because the sides are proportional to the Sines of the opposite Angles: therefore as the Sine

of the Angle S A I	7,071,068
is to the side S I	18, 226,268
so is the Sine of the angle S I A	3, 789, 268
to the side S A	9,842,653
which taken out of S A O, there is left A O	226,04
which hath the same proportion to	10,000,00
that the right line O B	275,67
hath to	12,036,02

whic



Paſt this upon the Margin of Letter Z. fol. 148 ſo as it may ly open all the while the following matter of the 20 and 21 chap. are reading.

	Deg. Mi. Se.
which is the Tangent of the Angle B A O	50-16-42
the distance of the Suns Apogeum from the midst of *Taurus*; that is, from the beginning of *Cancer*;	5-16-42
which, to avoid scrupulositie, we will make	5-17-0
the Sine whereof	7,692,137
is to the whole Sine	10,000,000
as the right line O B	275,678
is to B A the Suns Eccentricitie	358,388
wherof B E, the Radius of the Eccentrick, is	10,000,000

Which may yet also be more easily found by the Tetragonical Table, or Table of Roots and Squares, for taking A O and O B to be 2290, and 2757, their Squares will be 5,244,100. And 7,601,049. Which added together make 12,845,149. The Square Root or side whereof is 3584. The Suns Eccentricitie, in such parts whereof the Semidiameter of the Eccentrick B e containeth 100,000. Agreeing exactly with the Suns Eccentricitie, found by *Tycho Brahe Progymnasmat. Pag.*26.

The same may also be further confirmed thus: We have found the arch of the Suns Eccentrick from the beginning of *Aries* to the beginning of *Libra*, to be 184-5-26,
the excesse whereof above a Semicircle is 4-5-26,
the half of this is the arch I K 2-2-43
the Sine whereof I X (equal to A D) is 356,892
(whereof the semidiameter of the Eccentrick is 10,000,000)
which should be the Suns Eccentricitie, if his Apogeum were in the beginning of *Cancer*. But having found that the Suns Apogeum is about 5 degrees 17 minutes

of *Cancer*; therfore as the whole Sine	10,000,000
is to the Secant of 5 degr. 17 min.	10,042,667
so is A D in the Right Angled Triangle A D B	356,892
to A B the Eccentricitie of the Sun	358,414,

which hath not any sensible difference from that we found before.

But the place of the Suns Apogeum, found by the foresaid Observations, differeth from *Tycho* twenty minutes (if we add to his place of the Apogeum of the Sun 7 minutes, for the Motion of the Suns Apogeum in the ten years space betwixt his Observation and mine.) All which difference notwithstanding may arise by erring little more then half a quarter of a minute in

Obſerving the the Suns height about the midſt of *Tarus*. Which error although it be ſo ſmal that it may worthily be neglected, for whether of them ſoever you follow either his (Apogeum) or mine, for the making of the *Ephemerides* aud Tables enſuing, there cannot hereof ariſe any ſuch diſagreement as can by ſight be diſerned: yet in that ſmal difference that is (though inſenſible) I ſhall not unwillingly yeeld unto him, conſidering with how great Preparation, coſt, skill, diligence, and circumſpection every way he went about this buſineſs, as all they that have any judgment and uſe of Obſervation will eaſily grant. I ſay therefore not building only upon his authoritie (though in this kind it be greater then any others, yet known to the world) that (following the ordinary received *Hypotheſis* of an Eccentrick for ſaving the Suns apparent inequalitie of motion) the Suns Eccentricitie and place of his Apogeum, ſet down by *Tycho*, as before we have ſhewed, are in this our Age very agreeable to truth and without all ſuch error as can by ſenſe be diſcerned. And as for the difference that ſeemeth to be betwixt us, being ſo ſmal and inſenſible; ſo far ought it to be from breeding doubtfulneſs in any, that it may rather make not a little for the confirmation of the truth both of his and my Obſervations; ſo as none ſhall need to make ſcruple of the certaintie and infallibilitie of thoſe Tables of the Suns Declination, which for the Navigators uſe ſhall out of theſe grounds be gathered and diduced.

CHAP. XXI.

The middle motion of the Sun, Corrected out of the former Obſervations.

THE Eccentricitie therefore and Apogeum of the Sun being thus known, together with his true place (which by ſo exact Obſervation as we could in the year 1597. the 11. of *March* at noon, we found to be 0 degr. 57. min. 48. ſec. of *Aries*:) his middle motion from the beginning of *Aries* was alſo eaſily found after this manner.

Let *a* be the place of the Sun in his Eccentrick; *b* the Suns true place in the Zodiack.

B *a* a line drawn from the center of the Eccentrick to the center of the Sun.

A *d* a line drawn from the center of the Ecliptick Parallel to B *a*, ſhewing the middle place of the Sun in the Zodiack.

A B,

A B, a line drawn from the center of the Ecliptick, by the center of the Sun to the Zodiack, ſhewing the true place of the Sun.

Therefore the Angle B A D being 5. degr. 37. min. and conſequently the Angle B A I 95. degr. 37, min. becauſe D A I is a right Angle: the Angle *a* A I, found by Obſervation to be 0 degrees 57 min. 48. ſeconds, being ſubtracted from the Angle B A I, there ſhall remain the angle B A *a* in the Triangle B A *a* 94. degr. 39. min. 12 ſec. and two ſides alſo of the ſame Triangle being given *a* B 100.000 parts, and B A 3584 of the ſame parts, therefore by the doctrine of Triangles, the Angle B *a* A equal to *a* A *d* (becauſe B *a* and A D are Parallels) ſhall likewiſe be found to be 2. degrees 2. min. 52. ſec. (the Proſtapheræreſis or equation of the Sun at that time; which ſubtracted from E *b* the true motion of the Sun, that is 57. min. 58. ſec (adding thereto an whole circle) there ſhall remain the middle motion of the ſun from the beginning of *Aries*, E F G H *d*, 358. degr. 54. min 56. ſec. According to *Tycho* his Tables *Progymnaſmat*, *part.* 1. *page.* 59. (if we account the difference of Longitude between *London* and *Vraniburg* to be about 11. deg. 15. min. as by our beſt Sea-Charts it ſeemeth it ſhould be) it is then 358. degr. 55. min. 45. ſec. differing from the former only 49. ſec. Which difference may ariſe almoſt of one third part of a minute error in Obſerving the Meridian Altitude of the Sun: Notwithſtanding the account of the *Prutenick* Tables maketh it to be 358, degrees, 35. min. 15. ſec. differing from both the former about 20 minutes.

Thus having found, that neither in the place the Suns Apogeum, nor in his Eccentricitie or middle motion, there is any ſenſible difference betwixt the accounts ariſing out of *Tycho Brahe* his Obſervations and mine own; I have therefore here ſet down the Tables of the Suns middle motions altogether agreeable to thoſe of his; *Progymnaſmat. part.* 1. *pag.* 57. 58. 59. allowing only to his *Epochaes* ſo much more as is anſwerable to the difference of Longitude between the place of his Obſervation and mine, that is, to the *Epochaes* of the Suns middle motion of Longitude, 1. min. 52. ſec. anſwerable to 45. min. of an hour almoſt, or 11 degr. and ¼, that is, ſo much as the Citie of *London* ſeemeth to be more Weſterly then *Vraniburg*.

EPO-

EPOCHAES OF THE MIDDLE MOTIONS OF THE SVN.

Years	Apogeum. Si. P. Mi. Se.	Longitude. Si. P. Mi. Se.
1500	3 4 24 45	9 20 10 52
1520	3 4 39 45	9 20 20 6
1540	3 4 54 45	9 20 29 20
1560	3 5 9 45	9 20 38 35
1580	3 5 24 45	9 20 47 49
1600	3 5 39 45	9 20 57 4
1601	3 5 40 30	9 20 42 44
1602	3 5 41 15	9 20 28 25
1603	3 5 42 0	9 20 14 6
1604	3 5 42 45	9 20 58 54
1605	3 5 43 30	9 20 44 35
1606	3 5 44 15	9 20 30 16
1607	3 5 45 0	9 20 15 56
1608	3 5 45 45	9 21 0 45
1609	3 5 46 30	9 20 46 26
1610	3 5 47 15	9 20 32 7
1611	3 5 48 0	9 20 17 47
1612	3 5 48 45	9 21 2 36
1613	3 5 49 30	9 20 48 17
1614	3 5 50 15	9 20 33 58
1615	3 5 51 0	9 20 19 38
1616	3 5 51 45	9 21 4 7
1617	3 5 52 30	9 20 50 8
1618	3 5 53 15	9 20 35 48
1619	3 5 54 0	9 20 21 29
1620	3 5 54 45	9 21 6 18
1621	3 5 55 37	9 20 52 1
1622	3 5 56 15	9 20 37 39
1623	3 5 57 0	9 20 23 20
1624	3 5 57 45	9 21 8 9

Years	Apogeum. Si. P. Mi. Se.	Longitude. Si. P. Mi. Se.
1625	3 5 58 30	9 20 53 50
1626	3 5 59 15	9 20 39 30
1627	3 6 0 0	9 20 25 11
1628	3 6 0 45	9 21 10 0
1629	3 6 1 30	9 20 55 40
1630	3 6 2 15	9 20 41 21
1631	3 6 3 0	9 20 27 2
1632	3 6 3 45	9 21 11 51

Middle motions in single years until 20.

1	0 0 0 45	11 29 45 41
2	0 0 1 30	11 29 31 21
3	0 0 2 15	11 29 17 2
4	0 0 3 0	0 0 1 51
5	0 0 3 45	11 29 47 32
6	0 0 4 30	11 29 33 12
7	0 0 5 15	11 29 18 53
8	0 0 6 0	0 0 3 42
9	0 0 6 45	11 29 49 22
10	0 0 7 30	11 29 35 3
11	0 0 8 15	11 29 20 44
12	0 0 9 0	0 0 5 33
13	0 0 9 45	11 29 51 13
14	0 0 10 30	11 29 36 54
15	0 0 11 15	11 29 22 35
16	0 0 12 0	0 0 7 24
17	0 0 12 45	11 29 53 4
18	0 0 13 30	11 29 38 45
19	0 0 14 15	11 29 24 26
20	0 0 15 0	0 0 9 14

THE

THE SUNS EQUAL MOTION OF LONGITUDE.

In moneths of the common year.	S.	D.	M.	Se.
Ianu.	1	0	33	18
Febr.	1	28	9	11
Mar.	2	28	42	30
April.	3	28	16	39
May.	4	28	49	58
Iune.	5	28	24	7
Iuly.	6	23	57	26
Aug.	7	29	30	44
Sept.	8	29	4	54
Octob.	9	29	38	12
Nov.	10	29	12	22
Dec.	11	29	45	40

In moneths of the leap year.	S.	D.	M.	Se.
Ianu.	1	0	33	18
Febr.	1	29	8	20
Mar.	2	29	41	38
April.	3	29	15	48
May.	4	29	49	6
Iune.	5	29	23	16
Iuly.	6	29	56	34
Aug:	8	0	29	53
Sept:	9	0	4	3
Octob.	10	0	37	21
Nov:	11	0	11	31
Dec:	0	0	44	45

In Moneths.

In dayes:	Da	D.	M.	Se
	1	0	59	8
	2	1	58	17
	3	2	50	25
	4	3	56	33
	5	4	55	42
	6	5	54	50
	7	6	53	58
	8	7	53	7
	9	8	52	15
	10	9	51	23
	11	10	50	32
	12	11	49	40
	13	12	48	48
	14	13	47	57
	15	14	47	5
	16	15	46	13
	17	16	45	21
	18	10	44	30
	19	18	43	38
	20	19	42	47
	21	20	41	55
	22	21	41	3
	23	22	40	12
	24	23	39	20
	25	24	38	28
	26	25	37	37
	27	26	36	45
	28	27	35	53
	29	28	35	1
	30	29	34	10
	31	30	33	18

In houres	H	Mi.	S.
	1	2	28
	2	4	56
	3	7	24
	4	9	51
	5	12	19
	6	14	47
	7	17	15
	8	19	34
	9	22	11
	10	24	38
	11	27	6
	12	29	34
	13	32	2
	14	34	30
	15	36	58
	16	39	26
	17	41	53
	18	44	21
	19	46	49
	20	49	17
	21	51	45
	22	54	13
	23	56	40
	24	59	8

In houres

In minutes:	M	M.S.	M	M.S.
	0	0	0	30	1	14
	1	0	2	31	1	16
	2	0	5	32	1	19
	3	0	7	33	1	21
	4	0	10	34	1	24
	5	0	12	35	1	26
	6	0	15	36	1	29
	7	0	17	37	1	31
	8	0	20	38	1	34
	9	0	22	39	1	36
	10	0	25	40	1	39
	11	0	27	41	1	41
	12	0	30	42	1	43
	13	0	32	43	1	46
	14	0	34	44	1	48
	15	0	37	45	1	51
	16	0	39	46	1	53
	17	0	42	40	1	56
	18	0	44	48	1	58
	19	0	47	49	2	1
	20	0	49	50	2	3
	21	0	52	51	2	6
	22	0	54	52	2	8
	23	0	57	53	2	11
	24	0	59	54	2	13
	25	1	2	55	2	15
	26	1	4	56	2	18
	27	1	7	57	2	20
	28	1	9	58	2	23
	29	1	11	59	2	25
	30	1	14	60	2	28

CHAP. XXII.

A new Theorick of the Sun for the making of the Table of the Suns Prosthaphæreses following.

BVt for the making of the table of the Suns Prosthaphæreses, becauſe it may be gathered not only out of the obſervations of *Mars*, that both my ſelf, together with that honorable and learned Knight Sir. *Chriſtopher Heyden*, have taken for many yeeres; but alſo by the obſervations of that famous *Tycho* (as appeareth in the Appendix annexed to his *Progymnaſmata*, *pag.* 821) that the Suns eccentricitie ſhould be but half ſo much, as out of the former Hypotheſis we have found, the place of his Apogæum notwithſtanding and greateſt Prosthapæreſes remaining as before: we have therefore in ſtead of the former Hypotheſis of an Eccentrick deviſed another Theorick for the Sun, of an Homocentrick with a double Epicycle anſwerable to thoſe Obſervations after this manner: Let B C D be an homocentrical circle equal to the Eccentrick aforeſaid, (whoſe Semediameter A B admit to be 100,000 parts) in the circumference whereof, taking the center B, deſcribe the greater Epicycle E G, whole Semidiameter E B let be 2688. of the ſame parts, that is, three quarters of the fore ſaid Eccentricitie 3584. Alſo upon the center E, taken in the greater Epicycle, deſcribe the little Epicycle F H, and let the Radius or Semediameter thereof E H be 896 ſuch parts, that is one quarter of the former Eccentricitie of the Eccentrick. Let all theſe circles be moved about their own centers equally; the Homocentrick carrying about the center of the greater Epicycle from the Weſt Eaſtwards in the time that the Sun returneth againe to his Apogæum; the greater Epicycle moving about from Eaſt Weſtward in the ſame time alſo, and the leſſer Epicycle carrying about the center of the Sun contrariwiſe from Weſt Eaſtwards in half that time.

Moreover, let them be moved with this condition, that whenſoever the center of the great Epicycle B commeth to the place of the Suns Apogæum, the center of the little Epicycle ſhall be in the Apogeum of the greater, and the Sun in F next to B the great Epicycles center, and conſequently B E and F (that is, the centers of both the Epicycles and of the Sun comming all together into the ſame right line of the Suns Apogæum A G B F E H.

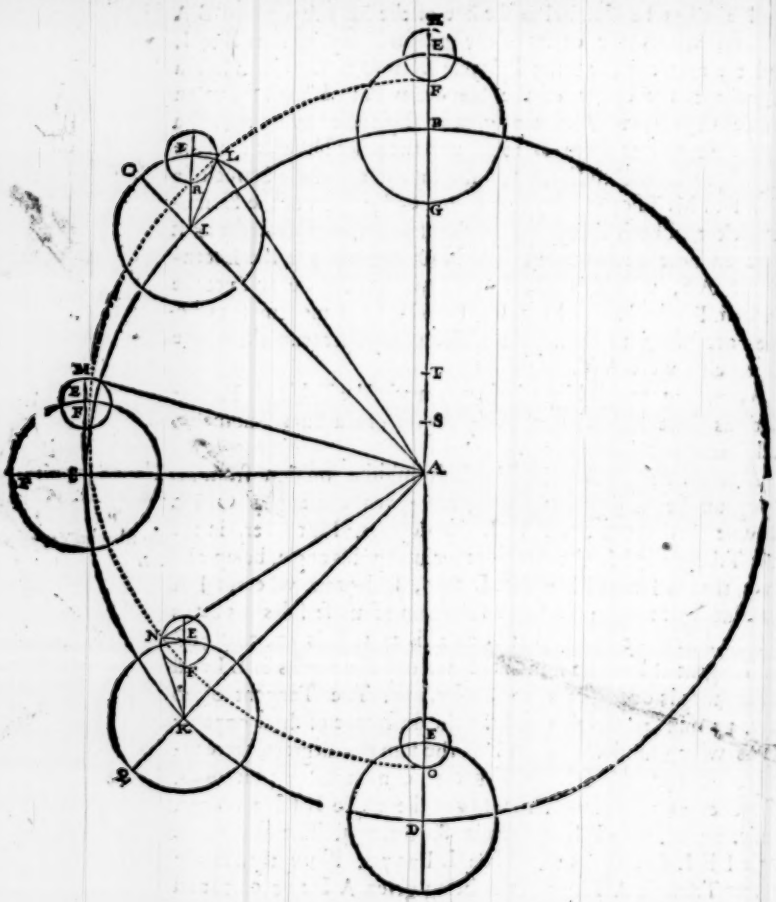
Hereof

Hereof it will follow that the Diameter of the greater Epicycle ſhall alwaies be Parallel to the line of the Suns Apogæum B A D, and whiles the center of the greater Epicycle from B to I, and the center of the leſſer Epicycle from O to E moveth half a Quadrant, the center of the Sun from R to L ſhall move an whole Quadrant. Alſo the greater Epicycle having moved a whole Quadrant from B to C, and the leſſer likewiſe a whole Quadrant from P to E, the Sun ſhall move an whole Semicircle from F to M. Therefore by this compound motion of the Homocentrick and both Epicycles, the Sun ſhall ſeem to deſcribe as it were an Eccentrical circle F L M N O, according to the Eccentricitie A S, which is but half ſo much as before, and yet the greateſt Proſtapharæſis M A C, ſhall be the ſame almoſt as before, according to the Hypotheſis of a ſimple Eccentrick, whoſe Eccetricitie were A T.

According to this Hypotheſis was made the Table of Proſtapharæſis here following, to every degree of the Suns Anomalie, and that after this manner.

The making of the Table of the Suns Proſthapharæſes.

Admit the angle B A I of the Suns middle motion from his Apogeum be 30 degrees: hereby are given the angles O I E likewiſe 30 degrees, and R E L 60 degrees. Moreover, in the little Triangle E I L, the two ſides including this angle, being alſo given, that is I E 2688, and E L 896, ſuch parts whereof I A containeth 100,000: therfore as the ſum of theſe ſides 3584 is to their difference 1792, that is, as 2 is to 1, ſo is 17,320,508 the Tangent of half the ſum of the two oppoſite angles E L I and L I E (that is 60 degrees) to 8,660,254, The Tangent of 40 degr. 53 min 36 ſec. that is, half the difference of thoſe oppoſite angles, which ſubducted from half the ſum 60 degrees, there remaineth the angle E I L 19 degrees, 6 minutes, 24 ſeconds. Moreover, as 3,273,278. The ſine of the angle L I E 19 degr. 6 min. 24 ſec. is to E L 896: ſo is 8,660,254. The ſine of the angle I E L 60 degrees to the ſide L I 2370. Now then in the greater Triangle A I L two ſides being given A I 100,000, and I L 2370, together with the angle L I A 130 degr. 53 min. 36 ſec. (becauſe it is the complement of the angle O I L to a ſemicircle, which angle being compounded of the angles O I E, 30 degr. and E I L 19 degr. 6 min. 24 ſec. is 49 degr. 6 min. 24 ſeconds) as the ſum of thoſe ſides 102,370 is to their difference 97,630, ſo is 45,685, (the Tangent of 24 degr. 33 min. 12 ſec. that is, the half of 49 degrees, 6 min. 24 ſec. which is the ſum of the angles at A and L) to 43,570, the Tangent of half the difference



difference of thoſe angles 23 degr. 32 min. 24 ſec. which being taken out of half the ſum of them 24 degr. 33 min. 12 ſec. there remaineth 1 degr. 0 min. 38 ſec. the Suns Proſthaphæreſis, when his motion of Anomalie or middle diſtance from his Apogeum is 30 degrees.

Thus we may find the Suns Proſthaphæreſes for every degree of his Anomalie, and ſo make this Table following.

De

De	0 Subt. Dig.	Mi.	Se	Diff. ad. Mi.	Sec.	1 Subtr. Deg.	M.	S.	Di. ad Mi.	Se.	2 Subtr. De.	Mi.	Se.	Di. ad Mi.	Se	De
0		0	0			1	0	38			1	45	41			30
1	0	2	7	2	7	1	2	28	1	50	1	46	46	1	5	29
2	0	4	13	2	6	1	4	17	1	49	1	47	48	1	2	28
3	0	6	20	2	7	1	6	5	1	48	1	48	49	1	1	27
4	0	8	26	2	6	1	7	51	1	46	1	49	48	0	59	26
5	0	10	33	2	7	1	9	37	1	46	1	50	45	0	57	25
6	0	12	39	2	6	1	11	21	1	44	1	51	40	0	55	24
7	0	14	45	2	6	1	13	4	1	43	1	52	33	0	53	23
8	0	16	51	2	6	1	14	46	1	42	1	53	24	0	51	22
9	0	18	56	2	5	1	16	26	1	40	1	54	11	0	48	21
10	0	21	1	2	5	1	18	5	1	39	1	54	59	0	47	20
11	0	23	6	2	5	1	19	43	1	38	1	55	44	0	45	19
12	0	25	10	2	4	1	21	19	1	36	1	56	27	0	43	18
13	0	27	14	2	4	1	22	54	1	35	1	57	7	0	40	17
14	0	29	17	2	3	1	24	27	1	33	1	57	46	0	39	16
15	0	31	20	2	3	1	25	59	1	32	1	58	22	0	36	15
16	0	33	22	2	2	1	27	29	1	30	1	58	57	0	35	14
17	0	35	24	2	2	1	28	58	1	29	1	59	29	0	32	13
18	0	37	25	2	1	1	30	25	1	27	1	59	59	0	30	12
19	0	39	26	2	1	1	31	51	1	26	2	0	26	0	27	11
20	0	41	26	2	0	1	33	15	1	24	2	0	52	0	26	10
21	0	43	25	1	59	1	34	37	1	22	2	1	15	0	23	9
22	0	45	23	1	58	1	35	58	1	21	2	1	37	0	22	8
23	0	47	20	1	57	1	37	17	1	19	2	1	56	0	19	7
24	0	49	17	1	57	1	38	34	1	17	2	2	12	0	16	6
25	0	51	13	1	56	1	39	50	1	16	2	2	27	0	15	5
26	0	53	8	1	55	1	41	4	1	14	2	2	39	0	12	4
27	0	55	2	1	54	1	42	16	1	12	2	2	50	0	11	3
28	0	56	55	1	53	1	43	26	1	10	2	2	58	0	8	2
29	0	58	47	1	52	1	44	34	1	8	2	3	3	0	5	1
30	1	0	38	1	51	1	45	41	1	7	2	3	7	0	4	0
D.	11	Add.		Dif. S.		10	Add.		Dif. S.		9	Add.		Dif. S.		D.

D.	3 Subtr. Deg.	Mi.	Se.	Dif. S. M.	Sec.	4 Subtr. Deg.	M.	S.	Dif. S. Mi.	Se.	5. Subtr. De.	Mi.	Se.	Dif. S. Mi.	Se.	D.
0	2	3	7			1	47	35			1	2	33			30
1	2	3	8	0	1	1	46	31	1	4	1	0	39	1	54	29
2	2	3	7	0	1	1	45	25	1	6	0	48	45	1	54	28
3	2	3	3	0	4	1	44	17	1	8	0	56	49	1	56	27
4	2	2	58	0	5	1	43	7	1	10	0	94	52	1	57	26
5	2	2	50	0	8	1	41	54	1	13	0	52	55	1	57	25
6	2	2	40	0	10	1	40	40	1	14	0	50	56	1	59	24
7	2	2	28	0	12	1	39	24	1	16	0	48	56	2	0	23
8	2	2	13	0	15	1	38	7	1	17	0	46	55	2	1	22
9	2	1	56	0	17	1	36	47	1	20	0	44	53	2	2	21
10	2	1	37	0	19	1	35	25	1	22	0	42	51	2	2	20
11	2	1	16	0	21	1	34	2	1	23	0	40	47	2	4	19
12	2	0	52	0	24	1	32	37	1	25	0	38	43	2	4	18
13	2	0	27	0	25	1	31	10	1	27	0	36	38	2	5	17
14	1	59	59	0	28	1	29	42	1	28	0	34	33	2	5	16
15	1	59	28	0	31	1	28	11	1	31	0	32	26	2	7	15
16	1	58	56	0	32	1	26	39	1	32	0	30	19	2	7	14
17	1	58	21	0	35	1	25	6	1	33	0	28	12	2	7	13
18	1	57	44	0	37	1	23	30	1	36	0	26	4	2	8	12
19	1	57	5	0	39	1	21	54	1	36	0	23	55	2	9	11
20	1	56	24	0	41	1	20	15	1	39	0	21	46	2	9	10
21	1	55	41	0	43	1	18	43	1	40	0	19	37	2	9	9
22	1	54	55	0	46	1	16	54	1	41	0	17	27	2	10	8
23	1	54	8	0	47	1	15	11	1	43	0	15	17	2	10	7
24	1	53	18	0	50	1	13	27	1	44	0	13	6	2	11	6
25	1	52	26	0	52	1	11	41	1	46	0	10	56	2	10	5
26	1	51	32	0	54	1	9	54	1	47	0	8	45	2	11	4
27	1	50	36	0	56	1	8	6	1	48	0	6	34	2	11	3
28	1	49	38	0	58	1	6	16	1	50	0	4	23	2	11	2
29	1	48	38	1	0	1	4	25	1	51	0	2	11	2	12	1
30	1	47	35	1	3	1	2	33	1	52	0	0	0	2	11	0
	8 Add.			Dif. ad		7 Add.			Dif. ad		6. Add.			Dif. ad		

CHAP.

Chap. XXIII.

The making of the Ephemerides of the Sun here following.

With help of the two former Tables of the Suns middle motions and of his prosthaphæreses, the Suns true place may be readily found, and so the Ephemerides following easily made, after this manner: Reduce the apparent time given to the equal time answering thereto, with help of *Tycho Brahe* his table of Equation of natural dayes; and for that time so reduced adde togeather the Suns middle motions of longitude in years, moneths, dayes, hours, and minutes: out of the summe subtract the place of the Suns Apogæum; the remainder shall be the Suns motion of Anomaly, or his distance from his Apogæum.

Now if this Anomaly be lesse then a semicircle, look the signe thereof in the head of the table of the Suns prostaphæreses, and the degree in the first column towards the left hand descending, and proceed in the same line towards the right hand, till you come under the foresaid sign of the Suns Anomaly, for there shall you have the Suns prostaphæresis for that time; remembring this withal, that if there be any minutes adhering to those degrees of Anomaly, that prostaphæresis must be corrected by the part of the adjacent difference proportional to these minutes, adding or subtracting the same hereto: according as you are directed in the head of the column, wherein that difference is set down.

But if the Suns Anomaly be more then a semicircle, you must finde the signes thereof in the foot of the table, and the degrees in the last column next the right hand ascending, and in the common meeting of the line wherein you finde this degree, and of the column of the said sign of the Suns Anomaly, you shall finde the Suns Prostaphæresis, as before; which if there be any minutes adherent to the Suns Anomaly, must be corrected by the part proportional of the difference adjoyning, as before; adding or subtracting the same, according as you finde your direction in the foot of the column containing that difference.

As for example: Suppose you would know the Suns true place the 6 of May at noon (that is, the 5 of May complete according to Astronomical account) in the year 1608, which time reduced to equality by the foresaid Table, shall be the 4 of May complete 23 hours, 48 minutes: for the Sun being at that time

about

about the 26 degree of *Taurus*, that Table sheweth you that 12 minutes are to be subtracted from the apparent time to make it equal. For this time therefore let the middle motions of the Sun be gathered together in this manner:

		Si.	*D.*	*M.*	*Se.*
The Suns middle motion of Longitude for	the year of Christ 1607 complete,	9	20	15	56
	Four moneths of the leap year,	3	29	15	48
	Four dayes,		3	56	33
	23 hours,			56	40
	48 minutes.			1	58

	Si.	*D.*	*M*	*S.*
The summe of all these is the Suns middle motion of Longitude for the time aforesaid.	1	24	26	55
The place of the Suns Apogæum for the year of Christ 1607 complete, is	3	5	45	0
The motion thereof in the moneths, dayes, hours, &c. remaining, is				15
which put together, make the place of the Suns Apogæum for the time aforesaid	3	5	45	15
This being subducted out of the Suns middle motion,	1	24	26	55
There shall remain the Suns motion of Anomaly	10	18	41	40
The Prosthaphæresis answerable to 10 signes, 18 degr. you shall find in the Table of Prosthaphæresis		1	21	19
with the difference answering thereto the part proportional whereof answering to 41 min. 40 seconds, you shall finde to be			1	36
which subtracted out of the Prosthaphæresis answering to 10 sig. 18 de.			1	7
there remaineth the Prosthaphæresis corrected		1	21	19
which being added to the Suns middle motion of Longitude for the time aforesaid	1	24	26	25
you shall have the Suns true place for that time	1	25	47	7

agreeing

agreeing juſtly with the Ephemerides following, where you ſhall finde the Sun at that time to be in 25 degr. 47 min, 7 ſec. of *Taurus*.

Admit alſo I would know the true place of the Sun the 27. of October 1609. at noon, as we commonly account, (that is) for the 26. of October complete, by the foreſaid account Aſtronomical, which reduced to the equal time, will make 25. dayes, 23. hours, 36. min. The Suns middle motion therefore, together with the reſt of the account, for finding the Suns true place for that time, may be ſhortly gathered after this manner:

		Si.	*D.*	*M*	*Se*
The Suns middle motion of Longitude for	the year of Chriſt 1608 complete,	9	21	0	45
	September of the common year, complete	8	29	4	54
	Five and twenty dayes		24	38	28
	Twenty three hours			56	40
	Thirty ſix minutes			1	29
The ſumme of theſe is the Suns middle motion of Longitude for that time:		7	15	42	14
From whence ſubtract the place of the Suns Apogæum,		3	5	46	18
there remaineth the Suns Anomalie;		4	9	55	56
whereby is found the Suns Proſthaphæreſis:			1	35	31
and by ſubtraction hereof, his true Longitude,		7	14	6	45

agreeing likewiſe juſtly with the Emphemerides following: after which manner alſo they may be wholy made. Notwithſtanding it is ſufficient to make ſome convenient part of them in this manner, and (for ſparing time and labour) to ſupply the reſt by convenient parts proportional, whereof there may ſomtimes ariſe ſome ſmall difference of a few ſeconds, which may worthily be neglected, ſeeing they can breed no ſenſible error in this buſineſs.

CHAP. XXIV.

How to reduce the apparent time to the equal time answering thereto.

NOtwithstanding the greatest difference between the apparent and equal time to be small, that by neglect thereof there can scarce at any time arise thereof so much as one minute error in the place of the Sun; and consequently not so much as half a minute error in his declination: yet because the rules and grounds of Arts ought so much as may be to be free from all error, I have therefore thought it better here to set down the foresaid Table of Equation of natural dayes, rather then to leave the Reader to seek any further for so small a matter, if any perhaps shall be desirous to exercise himself in calculating the Suns true place, according to the manner here before set down, either for the examining of the Suns Ephemerides here following, or any other; or for making some other like to these, when the date of them shall be expired; wherein, if perhaps you finde some little difference of a few seconds from your calculation, you need not therewith to be any thing troubled, seeing it cannot produce any sensible error, neither in the Suns declination, nor yet in his place.

A Table of Equation of natural dayes.

	♈	♉	♊	♋	♌	♍	♎	♏	♐	♑	♒	♓
	S	S	S	S	S	S	S	S	S	S	A	A
D.	M	Mi	Mi.	M	M	Mi.	Mi.	Mi.	Mi.	Mi.	M	M
2	0	9	12	6	2	6	16 ½	24	21	7	5	7
4	1	9 ½	11	6	2	7	17	24	20	6	6	7
6	1	10	11	5 ½	2	7	18	24	19 ½	5	6 ½	7
8	2	10	11	5	2	8	18	24 ½	19	4	6 ½	6 ½
10	3	11	11	5	2	9	19	24	18	3 ½	7	6
12	3	11	10	4	2	9	20	24	17	2 ½	7	6
14	4	11	10	4	3	10	20	24	16	2	7 ½	5
16	5	11	10	3 ½	3	11	21	24	15	1	8	5
18	5	11 ½	9	3	3	11 ½	21	24	14	0	8	4
20	6	12	9	3	3	12	22	23 ½	13 ½	A1	8	4
22	6	12	8 ½	3	4	13	22	23	12 ½	2	8	3
24	7	12	8	2 ½	4	13 ½	23	23	11 ½	3	8	2 ½
26	7 ½	12	8	2	5	14	23	22	10 ½	3	8	2
28	8	12	7	2	5	15	23	22	9 ½	4	8	1
30	8 ½	12	7	2	6	16	24	21	8 ½	5	7 ½	0 ½

This

This Table must be thus used: With the sign and degree of the Suns true place take out in the common meeting the minutes of time; which according to the letters A. S, in the head of the Table, must be added to or subtracted from the apparent time to make it equal: remembring to do contrariwise if the equal time must be changed into the apparent.

CHAP. XXV.

A Table of Equations of the Suns Ephemerides.

	Ianuary	*Febr.*	*March.*	*April.*	*May.*	*Iune.*
Day.	*Mi.Se*	*Mi.Se*	*Mi.Se*	*Mi.Se*	*Mi.Se*	*Mi.Se*
3	1 53	1 51	1 49	1 47	1 46	1 45
6	1 52	1 50	1 49	1 47	1 46	1 45
9	1 52	1 50	1 49	1 47	1 45	1 45
12	1 52	1 51	1 48	1 46	1 46	1 44
15	1 52	1 50	1 49	1 47	1 45	1 45
18	1 52	1 50	1 48	1 46	1 45	1 45
21	1 51	1 50	1 48	1 46	1 45	1 45
24	1 52	1 50	1 48	1 46	1 45	1 44
27	1 51	1 50	1 48	1 46	1 45	1 45
30	1 52		1 47	1 46	1 45	1 45

	Iuly.	*Auguſt*	*Sept.*	*Octob*	*Novem*	*Decem.*
Day.	*Mi.Se*	*Mi. Se.*	*Mi. Se.*	*Mi. Se.*	*Mi. Se.*	*Mi. Se.*
3	1 45	1 45	1 48	1 49	1 51	1 52
6	1 45	1 46	1 48	1 50	1 52	1 52
9	1 45	1 46	1 48	1 50	1 52	1 52
12	1 45	1 46	1 48	1 50	1 52	1 53
15	1 45	1 47	1 49	1 50	1 52	1 52
18	1 45	1 47	1 48	1 51	1 52	1 52
21	1 45	1 47	1 49	1 50	1 52	1 52
24	1 46	1 47	1 49	1 51	1 52	1 53
27	1 46	1 47	1 49	1 51	1 52	1 52
30	1 45	1 47	1 49	1 52	1 53	1 52

By means of this Table, and these Ephemerides, the true place of the Sun may most easily be found, for many years, either past, or to come; as shall hereafter be shewed in the next Chapter.

D	January. gr.	mi.	sec	D	February. gr.	mi.	se.	D	March. gr.	mi.	se.	D	April. gr.	mi	se	D	May. gr.	mi.	sec	D	June. gr.	mi.	sec
1	20	47	21	1	22	17	51	1	21	23	9	1	21	56	7	1	20	59	3	1	20	37	23
2	21	48	38	2	23	18	28	2	22	22	49	2	22	54	41	2	21	56	43	2	21	34	31
3	22	49	52	3	24	19	3	3	23	22	27	3	23	53	13	3	22	54	21	3	22	31	38
4	23	51	6	4	25	19	37	4	24	22	2	4	24	51	42	4	23	51	58	4	23	28	46
5	24	52	18	5	26	20	8	5	25	21	36	5	25	50	10	5	24	49	33	5	24	25	52
6	25	53	30	6	27	20	39	6	26	21	7	6	26	48	35	6	25	47	7	6	25	22	58
7	26	54	40	7	28	21	7	7	27	20	37	7	27	46	58	7	26	44	40	7	26	20	4
8	27	55	49	8	29	21	34	8	28	20	4	8	28	45	19	8	27	42	11	8	27	17	10
9	28	56	57	9	♓	21	59	9	29	19	28	9	29	43	37	9	28	39	41	9	28	14	15
10	29	58	5	10	1	22	22	10	♈	18	51	10	♉	41	55	10	29	37	9	10	29	11	20
11	♒	59	11	11	2	22	43	11	1	18	12	11	1	40	10	11	♊	34	36	11	♋	8	24
12	2	0	16	12	3	23	2	12	2	17	31	12	2	38	24	12	1	32	2	12	1	5	29
13	3	1	21	13	4	23	19	13	3	16	47	13	3	36	35	13	2	29	27	13	2	2	33
14	4	2	25	14	5	23	35	14	4	16	2	14	4	34	45	14	3	26	51	14	2	59	37
15	5	3	27	15	6	23	49	15	5	15	14	15	5	32	53	15	4	24	14	15	3	56	41
16	6	4	28	16	7	24	0	16	6	14	24	16	6	30	59	16	5	21	36	16	4	53	45
17	7	5	29	17	8	24	10	17	7	13	32	17	7	29	4	17	6	18	56	17	5	50	49
18	8	6	28	18	9	24	18	18	8	12	37	18	8	27	6	18	7	16	16	18	6	47	53
19	9	7	26	19	10	24	23	19	9	11	40	19	9	25	6	19	8	13	35	19	7	44	57
20	10	8	22	20	11	24	27	20	10	10	41	20	10	23	5	20	9	10	53	20	8	42	1
21	11	9	18	21	12	24	29	21	11	9	40	21	11	21	3	21	10	8	10	21	9	39	5
22	12	10	11	22	13	24	28	22	12	8	37	22	12	18	58	22	11	5	26	22	10	36	9
23	13	11	4	23	14	24	25	23	13	7	32	23	13	16	52	23	12	2	41	23	11	33	14
24	14	11	55	24	15	24	21	24	14	6	25	24	14	14	44	24	12	59	55	24	12	30	19
25	15	12	45	25	16	24	14	25	15	5	15	25	15	12	34	25	13	57	9	25	13	27	24
26	16	13	33	26	17	24	5	26	16	4	4	26	16	10	23	26	14	54	22	26	14	24	29
27	17	14	20	27	18	23	54	27	17	2	50	27	17	8	10	27	15	51	33	27	15	21	34
28	18	15	5	28	19	23	41	28	18	1	34	28	18	5	56	28	16	48	45	28	16	18	40
29	19	15	49	29	20	23	26	29	19	0	15	29	19	3	40	29	17	45	55	29	17	15	47
30	20	16	31					30	19	58	54	30	20	1	22	30	18	43	5	30	18	12	53
31	21	17	12					31	20	57	32					31	19	40	14				

D	July. gr.	mi.	se.	D	August gr.	mi.	se.	D	Septemb gr.	mi	se	D	October. gr.	mi.	se.	D	Novem. gr.	mi.	se.	D	Decemb. gr.	mi.	se
1	19	10	0	1	18	47	12	1	18	46	59	1	18	19	25	1	19	24	15	1	19	53	44
2	20	7	7	2	19	44	50	2	19	45	33	2	19	19	3	2	20	24	55	2	20	54	58
3	21	4	15	3	20	42	30	3	20	44	8	3	20	18	44	3	21	25	36	3	21	56	13
4	22	1	24	4	21	40	10	4	21	42	46	4	21	18	26	4	22	26	19	4	22	57	29
5	22	58	33	5	22	37	53	5	22	41	26	5	22	18	11	5	23	27	3	5	23	58	45
6	23	55	43	6	23	35	37	6	23	40	7	6	23	17	58	6	24	27	49	6	25	0	2
7	24	52	53	7	24	33	23	7	24	38	51	7	24	17	47	7	25	28	37	7	26	1	19
8	25	50	4	8	25	31	10	8	25	37	37	8	25	17	38	8	26	29	25	8	27	2	37
9	26	47	16	9	26	28	59	9	26	36	26	9	26	17	32	9	27	30	15	9	28	3	55
10	27	44	28	10	27	26	49	10	27	35	17	10	27	17	28	10	28	31	7	10	29	5	13
11	28	41	41	11	28	24	41	11	28	34	10	11	28	17	26	11	29	32	0	11	♍	6	32
12	29	38	55	12	29	22	35	12	29	33	5	12	29	17	27	12	♎	32	55	12	1	7	50
13	♌	36	10	13	♍	20	31	13	♏	32	2	13	♏	17	29	13	1	33	51	13	2	9	9
14	1	33	26	14	1	18	28	14	1	31	1	14	1	17	33	14	2	34	49	14	3	10	29
15	2	30	42	15	2	16	27	15	2	30	2	15	2	17	39	15	3	35	47	15	4	11	48
16	3	28	0	16	3	14	28	16	3	29	6	16	3	17	47	16	4	36	47	16	5	13	7
17	4	25	19	17	4	12	31	17	4	28	12	17	4	17	57	17	5	37	48	17	6	14	26
18	5	22	38	18	5	10	35	18	5	27	20	18	5	18	9	18	6	38	50	18	7	15	45
19	6	19	59	19	6	8	42	19	6	26	30	19	6	18	23	19	7	39	53	19	8	17	3
20	7	17	22	20	7	6	50	20	7	25	43	20	7	18	40	20	8	40	58	20	9	18	22
21	8	14	43	21	8	5	0	21	8	24	53	21	8	18	58	21	9	42	3	21	10	19	40
22	9	12	6	22	9	3	12	22	9	24	15	22	9	19	18	22	10	43	9	22	11	20	58
23	10	9	31	23	10	1	26	23	10	23	34	23	10	19	39	23	11	44	17	23	12	22	16
24	11	6	57	24	10	59	42	24	11	22	55	24	11	20	3	24	12	45	25	24	13	23	34
25	12	4	25	25	11	57	59	25	12	22	18	25	12	20	29	25	13	46	34	25	14	24	52
26	13	1	53	26	12	56	18	26	13	21	43	26	13	20	56	26	14	47	44	26	15	26	9
27	13	59	23	27	13	54	40	27	14	21	11	27	14	21	25	27	15	48	55	27	16	27	26
28	14	56	54	28	14	53	0	28	15	20	41	28	15	21	55	28	16	50	6	28	17	28	43
29	15	54	27	29	15	51	29	29	16	20	13	29	16	22	28	29	17	51	18	29	18	29	59
30	16	52	1	30	16	49	57	30	17	19	48	30	17	23	1	30	18	52	30	30	19	31	15
31	17	49	36	31	17	48	82					31	18	23	38					31	20	32	30

January.

D	gr.	mi.	se.
1	21	33	47
2	22	35	2
3	23	36	16
4	24	37	29
5	25	38	40
6	26	39	51
7	27	41	0
8	28	42	9
9	29	43	16
10	♒	44	22
11	1	45	28
12	2	46	33
13	3	47	37
14	4	48	39
15	5	49	41
16	6	50	42
17	7	51	41
18	8	52	39
19	9	53	36
20	10	54	32
21	11	55	26
22	12	56	19
23	13	57	10
24	14	58	0
25	15	58	49
26	16	59	36
27	18	0	22
28	19	1	6
29	20	1	49
30	21	2	30
31	22	3	9

Februar

D	gr.	mi.	se.
1	23	3	46
2	24	4	22
3	25	4	56
4	26	5	28
5	27	5	59
6	28	6	23
7	29	6	55
8	♓	7	20
9	1	7	43
10	2	8	5
11	3	8	25
12	4	8	43
13	5	8	59
14	6	9	13
15	7	9	25
16	8	9	35
17	9	9	43
18	10	9	50
19	11	9	54
20	12	9	56
21	13	9	56
22	14	9	54
23	15	9	49
24	16	9	43
25	17	9	35
26	18	9	24
27	19	9	12
28	20	8	57

March.

D	gr.	mi	se.
1	21	8	40
2	22	8	21
3	23	8	0
4	24	7	36
5	25	7	10
6	26	6	42
7	27	6	12
8	28	5	39
9	29	5	4
10	♈	4	28
11	1	3	49
12	1	3	8
13	3	2	25
14	4	1	41
15	5	0	53
16	6	0	4
17	6	59	12
18	7	58	18
19	8	57	21
20	9	56	23
21	10	55	22
22	11	54	20
23	12	53	15
24	13	52	8
25	14	51	0
26	15	49	49
27	16	48	35
28	17	47	20
29	18	46	0
30	19	44	41
31	20	43	19

April.

D	gr.	mi.	se.
1	21	41	55
2	22	40	29
3	23	39	2
4	24	37	32
5	25	36	0
6	26	34	25
7	27	32	49
8	28	31	10
9	29	29	29
10	♉	27	47
11	1	26	3
12	2	24	17
13	3	22	29
14	4	20	40
15	5	18	48
16	6	16	55
17	7	14	59
18	8	13	2
19	9	11	3
20	10	9	2
21	11	7	0
22	12	4	56
23	13	2	50
24	14	0	42
25	14	58	33
26	15	56	22
27	16	54	10
28	17	51	56
29	18	49	40
30	19	47	23

May

D	gr.	mi.	se.
1	20	45	5
2	21	42	44
3	22	40	23
4	23	38	0
5	24	35	36
6	25	33	10
7	26	30	43
8	27	28	14
9	28	25	44
10	29	23	13
11	♊	20	41
12	1	18	7
13	2	15	32
14	3	12	56
15	4	10	19
16	5	7	41
17	6	5	3
18	7	2	23
19	7	59	42
20	8	57	0
21	9	54	17
22	10	51	33
23	11	48	49
24	12	46	3
25	13	43	17
26	14	40	30
27	15	37	42
28	16	34	53
29	17	32	4
30	18	29	14
31	19	26	23

June.

D	gr.	m.	se
1	20	23	32
2	21	20	40
3	22	17	48
4	23	14	55
5	24	12	2
6	25	9	8
7	26	6	14
8	27	3	19
9	28	0	25
10	28	57	30
11	29	54	34
12	♋	51	39
13	1	48	43
14	2	45	47
15	3	42	51
16	4	39	55
17	5	36	59
18	6	34	3
19	7	31	7
20	8	28	11
21	9	25	15
22	10	22	20
23	11	19	24
24	12	16	29
25	13	13	34
26	14	10	39
27	15	7	34
28	16	4	50
29	17	1	56
30	17	59	3

July.

D	gr.	mi.	se.
1	18	56	9
2	19	53	17
3	20	50	24
4	21	47	33
5	22	44	42
6	23	41	51
7	24	39	2
8	25	36	13
9	26	33	24
10	27	30	36
11	28	27	49
12	29	25	3
13	♌	22	18
14	1	19	33
15	2	16	49
16	3	14	7
17	4	11	25
18	5	8	44
19	6	6	6
20	7	3	28
21	8	0	49
22	8	58	12
23	9	55	36
24	10	53	2
25	11	50	26
26	12	47	52
27	13	45	27
28	14	42	58
29	15	40	35
30	16	38	13
31	17	35	52

August.

D	gr	mi.	se.
1	18	33	14
2	19	30	52
3	20	28	31
4	21	26	12
5	22	23	54
6	23	21	37
7	24	19	23
8	25	17	10
9	26	14	58
10	27	12	48
11	28	10	40
12	29	8	33
13	♍	6	28
14	1	4	25
15	2	2	24
16	3	0	24
17	3	58	27
18	4	56	31
19	5	54	37
20	6	52	45
21	7	50	55
22	8	49	6
23	9	47	20
24	10	45	36
25	11	43	52
26	12	42	10
27	13	40	31
28	14	38	54
29	15	37	19
30	16	35	47
31	17	34	16

Septemb

D	gr.	mi.	se.
1	18	32	48
2	19	31	21
3	20	29	56
4	21	28	33
5	22	27	12
6	23	25	54
7	24	24	38
8	25	23	23
9	26	22	11
10	27	21	1
11	28	19	53
12	29	18	48
13	♎	17	45
14	1	16	43
15	2	15	44
16	3	14	47
17	4	13	52
18	5	13	0
19	6	12	10
20	7	11	22
21	8	10	36
22	9	9	53
23	10	9	11
24	11	8	32
25	12	7	54
26	13	7	19
27	14	6	46
28	15	6	16
29	16	5	47
30	17	5	22

October.

D	gr.	mi.	se.
1	18	4	58
2	19	4	36
3	20	4	16
4	21	3	58
5	22	3	42
6	23	3	29
7	24	3	17
8	25	3	8
9	26	3	1
10	27	2	57
11	28	2	54
12	29	2	54
13	♏	2	56
14	1	2	59
15	2	3	5
16	3	3	13
17	4	3	22
18	5	3	34
19	6	3	48
20	7	4	3
21	8	4	21
22	9	4	40
23	10	5	2
24	11	5	25
25	12	5	50
26	13	6	17
27	14	6	45
28	15	7	15
29	16	7	47
30	17	8	21
31	18	8	57

Novemb

D	gr.	mi.	sec
1	19	9	34
2	20	10	13
3	21	10	54
4	22	11	36
5	23	12	20
6	24	13	6
7	25	13	53
8	26	14	41
9	27	15	31
10	28	16	22
11	29	17	15
12	♐	18	9
13	1	19	5
14	2	20	2
15	3	21	1
16	4	22	0
17	5	23	1
18	6	24	3
19	7	25	6
20	8	26	10
21	9	27	15
22	10	28	21
23	11	29	28
24	12	30	36
25	13	31	45
26	14	32	55
27	15	34	5
28	16	35	16
29	17	36	28
30	18	37	40

Decembe

D	gr.	m.	sec.
1	19	38	53
2	20	40	7
3	21	41	22
4	22	42	38
5	23	43	54
6	24	45	11
7	25	46	28
8	26	47	45
9	27	49	3
10	28	50	22
11	29	51	40
12	♑	52	59
13	1	54	18
14	2	55	37
15	3	56	56
16	4	58	15
17	5	59	34
18	7	0	53
19	8	2	11
20	9	3	30
21	10	4	49
22	11	6	7
23	12	7	25
24	13	8	43
25	14	10	1
26	15	11	18
27	16	12	35
28	17	13	52
29	18	15	8
30	19	16	24
31	20	17	39

D	January. gr.	mi.	se.	D	February. gr.	mi.	se.	D	March. gr.	mi.	se.	D	April. gr.	mi.	se.	D	May gr.	mi.	se	D	June. gr.	mi.	se.
1	21	18	56	1	22	49	5	1	20	54	12	1	21	27	43	1	20	31	6	1	20	9	41
2	22	20	11	2	23	49	41	2	21	53	53	2	22	26	18	2	21	28	46	2	21	6	49
3	23	21	25	3	24	50	15	3	22	53	32	3	23	24	50	3	22	26	25	3	22	3	57
4	24	22	38	4	25	50	48	4	23	53	9	4	24	23	21	4	23	24	2	4	23	1	4
5	25	23	50	5	20	51	19	5	24	52	44	5	25	21	50	5	24	21	38	5	23	58	11
6	26	25	1	6	7	51	48	6	25	52	16	6	26	20	16	6	25	19	13	6	24	55	18
7	27	26	51	7	26	52	16	7	26	51	46	7	27	18	40	7	26	16	40	7	25	52	24
8	28	27	19	8	29	52	41	8	27	51	15	8	28	17	2	8	27	14	18	8	26	49	29
9	29	28	27	9	♓	53	5	9	28	50	40	9	29	15	21	9	28	11	48	9	27	46	35
10	♒	29	34	10	1	53	27	10	29	50	4	10	♉	13	39	10	29	9	17	10	28	43	40
11	1	30	40	11	2	53	48	11	♈	49	26	11	1	11	56	11	♊	6	45	11	29	40	44
12	2	31	45	12	3	54	6	12	1	48	46	12	2	10	10	12	1	4	12	12	♋	37	49
13	3	32	49	13	4	54	22	13	2	48	3	13	3	8	23	13	2	1	37	13	1	34	53
14	4	33	52	14	5	54	37	14	3	47	19	14	4	6	34	14	2	59	2	14	2	31	57
15	5	34	54	15	6	54	50	15	4	46	32	15	5	4	43	15	3	56	25	15	3	29	2
16	6	35	54	16	7	55	0	16	5	45	44	16	6	2	50	16	4	53	47	16	4	26	6
17	7	36	54	17	8	55	9	17	6	44	52	17	7	0	55	17	5	51	9	17	5	23	9
18	8	37	53	18	9	55	16	18	7	43	59	18	7	58	58	18	6	48	29	18	6	20	13
19	9	38	50	19	10	55	20	19	8	43	3	19	8	56	59	19	7	45	48	19	7	17	17
20	10	39	46	20	11	55	23	20	9	42	5	20	9	54	59	20	8	42	7	20	8	14	21
21	11	40	40	21	12	55	23	21	10	41	5	21	10	52	57	21	9	40	24	21	9	11	25
22	12	41	34	22	13	55	22	22	11	40	2	22	11	50	53	22	10	37	41	22	10	8	30
23	13	42	25	23	14	55	18	23	12	38	58	23	12	48	48	23	11	34	56	23	11	5	34
24	14	43	16	24	15	55	12	24	13	37	52	24	13	46	41	24	12	32	11	24	12	2	39
25	15	44	5	25	16	55	4	25	14	36	44	25	14	44	32	25	13	29	25	25	12	59	43
26	16	44	52	26	17	54	54	26	15	35	33	26	15	42	22	26	14	26	38	26	13	56	46
27	17	45	38	27	18	54	43	27	16	34	20	27	16	40	10	27	15	23	50	27	14	53	48
28	18	46	23	28	19	54	28	28	17	33	5	28	17	37	56	28	16	21	1	28	15	51	0
29	19	47	6					29	18	31	48	29	18	35	41	29	17	18	12	29	16	48	6
30	20	47	47					30	19	30	28	30	19	33	24	30	18	15	22	30	7	45	12
31	21	48	27					31	20	29	7					31	19	12	32				

D	July gr.	mi.	se	D	August. gr.	mi.	se	D	Septembe gr.	mi.	sec	D	October. gr.	mi	se.	D	Novemb. gr,	mi.	sec	D	Decemb. gr.	mi.	sec
1	18	42	19	1	18	19	17	1	18	18	37	1	17	50	31	1	18	54	52	1	19	24	3
2	19	39	26	2	19	16	54	2	19	17	10	2	18	50	9	2	19	55	31	2	20	25	17
3	20	36	34	3	20	14	33	3	20	15	44	3	19	49	48	3	20	56	11	3	21	26	32
4	21	33	42	4	21	12	13	4	21	14	21	4	20	49	30	4	21	56	53	4	22	27	47
5	22	30	51	5	22	9	55	5	22	12	59	5	21	49	13	5	22	57	37	5	23	29	3
6	23	28	0	6	23	7	38	6	23	11	40	6	22	48	59	6	23	58	22	6	24	30	22
7	24	25	10	7	24	5	23	7	24	10	23	7	23	48	47	7	24	59	3	7	25	31	37
8	25	22	21	8	25	3	9	8	25	9	8	8	24	48	37	8	25	59	57	8	26	32	54
9	26	19	32	9	26	0	57	9	26	7	56	9	25	48	30	9	27	0	46	9	27	34	12
10	27	16	45	10	26	58	47	10	27	6	45	10	26	48	25	10	28	1	37	10	28	35	30
11	28	13	57	11	27	56	38	11	28	5	37	11	27	48	22	11	29	2	30	11	29	36	49
12	29	11	11	12	28	54	31	12	29	4	31	12	28	48	22	12	♎	3	23	12	♍	38	7
13	♌	8	25	13	29	52	26	13	♏	3	27	13	29	48	23	13	1	4	19	13	1	39	26
14	1	5	40	14	♍	50	23	14	1	2	25	14	♍	48	26	14	2	5	16	14	2	40	45
15	2	2	57	15	1	48	21	15	2	1	26	15	1	48	31	15	3	6	14	15	3	42	4
16	3	0	14	16	2	46	21	16	3	0	28	16	2	48	38	16	4	7	13	16	4	43	24
17	3	57	32	17	3	44	23	17	3	59	33	17	3	48	47	17	5	8	14	17	5	44	43
18	4	54	51	18	4	42	26	18	4	58	40	18	4	48	58	18	6	9	15	18	6	46	1
19	5	52	11	19	5	40	32	19	5	57	49	19	5	49	12	19	7	10	18	19	7	47	20
20	6	49	32	20	6	38	39	20	6	57	1	20	6	49	27	20	8	11	22	20	8	48	39
21	7	46	54	21	7	36	49	21	7	56	15	21	7	49	44	21	9	12	26	21	9	49	57
22	8	44	17	22	8	35	0	22	8	55	31	22	8	50	3	22	10	13	32	22	10	51	16
23	9	41	42	23	9	33	13	23	9	54	49	23	9	50	24	23	11	14	39	23	11	52	34
24	10	39	7	24	10	31	27	24	10	54	9	24	10	50	47	24	12	15	47	24	12	53	52
25	11	36	34	25	11	29	44	25	11	53	31	25	11	51	11	25	13	16	56	25	13	55	9
26	12	34	2	26	12	28	0	26	12	52	55	26	12	51	38	26	14	18	5	26	14	56	27
27	13	31	31	27	13	26	22	27	13	52	21	27	13	52	6	27	15	19	15	27	15	57	44
28	14	29	2	28	14	24	45	28	14	51	50	28	14	52	36	28	16	20	26	28	16	59	1
29	15	26	33	29	15	23	10	29	15	51	22	29	15	53	7	29	17	21	38	29	18	0	17
30	16	24	7	30	16	21	36	30	16	50	55	30	16	53	40	30	18	22	50	30	19	1	33
31	17	21	41	31	17	20	5					31	17	54	15					31	20	2	48

January.				February.				March.				April.				May.				June.			
D	gr.	mi.	sec	D	gr	mi.	se.	D	gr.	mi.	se.	D	gr.	mi	se	D	gr.	mi	sec	D	gr.	mi.	sec
1	21	4	5	1	22	34	23	1	20	39	44	1	21	13	31	1	20	17	7	1	19	55	50
2	22	5	21	2	23	35	0	2	21	39	26	2	22	12	6	2	21	14	48	2	20	52	58
3	23	6	35	3	24	35	35	3	22	39	5	3	23	10	39	3	22	12	27	3	21	50	6
4	24	7	48	4	25	36	8	4	23	38	43	4	24	9	10	4	23	10	4	4	22	47	14
5	25	9	0	5	26	36	39	5	24	38	18	5	25	7	39	5	24	7	41	5	23	44	21
6	26	10	11	6	27	37	9	6	25	37	51	6	26	6	6	6	25	5	16	6	24	41	27
7	27	11	21	7	28	37	37	7	26	37	21	7	27	4	31	7	26	2	49	7	25	38	33
8	28	12	30	8	29	38	3	8	27	36	50	8	28	2	53	8	27	0	21	8	26	35	39
9	29	13	38	9	♓	38	27	9	28	36	17	9	29	1	13	9	27	57	52	9	27	32	44
10	♒	14	45	10	1	38	50	10	29	35	41	10	29	53	32	10	28	55	22	10	28	29	50
11	1	15	51	11	2	39	10	11	♈	35	3	11	29	52	50	11	29	52	50	11	29	26	54
12	2	16	56	12	3	39	29	12	1	34	23	12	1	56	4	12	♊	50	17	12	♋	24	0
13	3	18	1	13	4	39	46	13	2	33	41	13	2	54	17	13	1	47	43	13	1	21	3
14	4	19	4	14	5	40	1	14	3	32	58	14	3	52	28	14	2	45	7	14	2	18	8
15	5	20	6	15	6	40	14	15	4	32	12	15	4	50	37	15	3	42	31	15	3	15	12
16	6	21	7	16	7	40	25	16	5	31	23	16	5	48	45	16	4	39	53	16	4	12	16
17	7	22	7	17	8	40	35	17	6	30	33	17	6	46	50	17	5	37	15	17	5	9	20
18	8	23	6	18	9	40	42	18	7	29	40	18	7	44	54	18	6	34	35	18	6	6	24
19	9	24	4	19	10	40	47	19	8	28	44	19	8	42	56	19	7	31	55	19	7	3	28
20	10	25	0	20	11	40	50	20	9	27	47	20	9	40	56	20	8	28	14	20	8	0	32
21	11	25	55	21	12	40	51	21	10	26	47	21	10	38	54	21	9	26	31	21	8	57	36
22	12	26	48	22	13	40	50	22	11	25	45	22	11	36	51	22	10	23	48	22	9	54	40
23	13	27	40	23	14	40	47	23	12	24	42	23	12	34	46	23	11	21	4	23	10	51	44
24	14	28	31	24	15	40	41	24	13	23	36	24	13	32	39	24	12	18	18	24	11	48	49
25	15	29	21	25	16	40	34	25	14	22	28	25	14	30	31	25	13	15	33	25	12	45	53
26	16	30	8	26	17	40	25	26	15	21	18	26	15	28	21	26	14	12	46	26	13	42	58
27	17	30	55	27	18	40	13	27	16	20	6	27	16	26	9	27	15	9	54	27	14	39	54
28	18	31	40	28	19	40	0	28	17	18	51	28	17	23	56	28	16	7	10	28	15	37	9
29	19	32	23					29	18	17	35	29	18	21	41	29	17	4	21	29	16	34	15
30	20	33	5					30	19	16	15	30	19	19	25	30	16	1	31	30	17	31	22
31	21	33	45					31	20	14	54					31	18	58	41				

July.				August.				Septemb.				October.				Novem.				Decemb.			
D	gr.	mi.	se.	D	gr.	mi.	se.	D	gr.	mi.	se	D	gr.	mi.	se.	D	gr.	mi.	se.	D	gr.	mi.	se
1	18	28	28	1	18	5	19	1	18	4	25	1	17	36	4	1	18	40	11	1	19	9	13
2	19	25	35	2	19	2	56	2	19	2	48	2	18	35	41	2	19	40	49	2	20	10	26
3	20	22	43	3	20	0	34	3	20	1	32	3	19	35	21	3	20	41	29	3	21	11	41
4	21	19	51	4	20	58	14	4	21	0	8	4	20	35	2	4	21	42	10	4	22	12	56
5	22	17	0	5	21	55	55	5	21	58	46	5	21	34	45	5	22	42	54	5	23	14	12
6	23	14	9	6	22	53	38	6	22	57	26	6	22	34	30	6	23	43	38	6	24	15	29
7	24	11	19	7	23	51	23	7	23	56	9	7	23	34	17	7	24	44	19	7	25	16	45
8	25	8	29	8	24	49	9	8	24	54	53	8	24	34	7	8	25	45	12	8	26	18	3
9	26	5	41	9	25	46	56	9	25	53	40	9	25	33	59	9	26	46	2	9	27	19	20
10	27	2	53	10	26	44	56	10	26	52	30	10	26	33	54	10	27	47	52	10	28	20	39
11	28	0	5	11	27	42	37	11	27	51	20	11	27	33	50	11	28	47	44	11	29	21	57
12	28	57	19	12	28	40	29	12	28	50	14	12	28	33	49	12	29	48	38	12	♍	23	16
13	29	54	33	13	29	38	24	13	29	49	10	13	29	33	50	13	♑	49	33	13	1	24	34
14	♌	51	48	14	♍	36	20	14	♎	48	8	14	♏	33	52	14	1	50	29	14	2	25	54
15	1	49	4	15	1	34	18	15	1	47	7	15	1	33	57	15	2	51	27	15	3	27	13
16	2	46	21	16	2	32	17	16	2	46	9	16	2	34	4	16	3	52	26	16	4	28	32
17	3	43	39	17	3	30	19	17	3	45	13	17	3	34	12	17	4	53	26	17	5	29	51
18	4	40	57	18	4	28	22	18	4	44	20	18	4	34	23	18	5	54	28	18	6	31	10
19	5	38	17	19	5	26	27	19	5	43	29	19	5	34	36	19	6	55	30	19	7	32	29
20	6	35	38	20	6	24	34	20	6	42	40	20	6	34	50	20	7	56	33	20	8	33	47
21	7	33	0	21	7	22	43	21	7	41	53	21	7	35	7	21	8	57	38	21	9	35	6
22	8	30	23	22	8	20	53	22	8	41	9	22	8	35	26	22	9	58	44	22	10	36	24
23	9	27	47	23	9	19	6	23	9	40	26	23	9	35	46	23	10	59	50	23	11	37	42
24	10	25	12	24	10	17	20	24	10	39	46	24	10	36	8	24	12	0	58	24	12	39	0
25	11	22	38	25	11	15	36	25	11	39	7	25	11	36	32	25	13	2	6	25	13	40	18
26	12	20	6	26	12	13	54	26	12	38	31	26	12	36	58	26	14	3	16	26	14	41	35
27	13	17	35	27	13	12	14	27	13	37	57	27	13	37	26	27	15	4	26	27	15	42	53
28	14	15	5	28	14	10	36	28	14	37	25	28	14	37	56	28	16	5	36	28	16	44	9
29	15	12	37	29	15	9	0	29	15	36	56	29	15	38	27	29	17	6	48	29	17	45	26
30	16	10	9	30	16	7	26	30	16	36	29	30	16	38	59	30	18	8	0	30	18	46	42
31	17	7	44	31	17	5	55					31	17	39	34					31	19	47	58

D	January. gr.	mi.	se.	D	February. gr.	mi.	se.	D	March. gr.	mi.	se.	D	April. gr.	mi.	se.	D	May. gr.	mi.	se.	D	June. gr.	mi.	se.
1	20	49	14	1	22	19	42	1	21	24	58	1	21	57	55	1	21	0	49	1	20	39	8
2	21	50	30	2	♓	20	19	2	22	24	38	2	22	56	28	2	21	58	29	2	21	36	16
3	22	51	45	3	24	20	54	3	23	24	16	3	23	55	0	3	22	56	7	3	22	33	23
4	23	52	58	4	25	21	28	4	24	23	52	4	24	53	29	4	23	53	43	4	23	30	30
5	24	54	11	5	26	21	59	5	25	23	25	5	25	51	57	5	24	51	19	5	24	27	37
6	25	55	22	6	27	22	29	6	26	22	56	6	26	50	22	6	25	48	53	6	25	24	23
7	26	56	32	7	28	22	58	7	27	22	26	7	27	48	45	7	26	46	25	7	26	21	49
8	27	57	41	8	29	23	24	8	28	21	53	8	28	47	5	8	27	43	56	8	27	18	54
9	28	58	49	9	♈	23	49	9	29	21	17	9	29	45	24	9	28	41	26	9	28	16	0
10	29	59	57	10	1	24	12	10	♈	20	40	10	♉	43	41	10	29	38	54	10	29	13	4
11	♉	1	3	11	2	24	33	11	1	20	1	11	1	41	57	11	♊	36	22	11	♋	10	10
12	2	2	8	12	3	24	53	12	2	19	19	12	2	40	10	12	1	33	48	12	1	7	13
13	3	3	13	13	4	25	10	13	3	18	36	13	3	38	22	13	2	31	12	13	2	4	18
14	4	4	16	14	5	25	25	14	4	17	51	14	4	36	32	14	3	28	36	14	3	1	22
15	5	5	19	15	6	25	39	15	5	17	3	15	5	34	40	15	4	25	59	15	3	58	26
16	6	6	20	16	7	25	51	16	6	16	13	16	6	32	46	16	5	23	21	16	4	55	30
17	7	7	20	17	8	26	0	17	7	15	20	17	7	30	50	17	6	20	42	17	5	52	34
18	8	8	20	18	9	26	8	18	8	14	25	18	8	28	52	18	7	18	1	18	6	49	38
19	9	9	17	19	10	26	14	19	9	13	28	19	9	26	53	19	8	14	20	19	7	46	42
20	10	10	14	20	11	26	17	20	10	12	29	20	10	24	52	20	9	12	38	20	8	43	46
21	11	11	9	21	12	26	19	21	11	11	28	21	11	22	49	21	10	9	55	21	9	40	50
22	12	12	3	22	13	26	18	22	12	10	25	22	12	20	44	22	11	7	11	22	10	37	54
23	13	12	56	23	14	26	15	23	13	9	20	23	13	18	38	23	12	4	26	23	11	34	59
24	14	13	47	24	15	26	11	24	14	8	13	24	14	16	30	24	13	1	40	24	12	32	3
25	15	14	36	25	16	26	4	25	15	7	3	25	15	14	20	25	13	58	54	25	13	29	8
26	16	15	24	26	17	25	55	26	16	5	51	26	16	12	9	26	14	56	6	26	14	26	4
27	17	16	11	27	18	25	44	27	17	4	37	27	17	9	56	27	15	53	18	27	15	23	19
28	18	16	57	28	19	25	31	28	18	3	21	28	18	7	42	28	16	50	29	28	16	20	25
29	19	17	41	29	20	25	16	29	19	2	2	29	19	5	25	29	17	47	40	29	17	17	31
30	20	18	23					30	20	0	42	30	20	3	8	30	18	44	50	30	18	14	38
31	21	19	3					31	20	59	19					31	19	41	59				

D	July. gr.	mi.	se.	D	August. gr.	mi.	se.	D	September. gr.	mi.	se.	D	October. gr.	mi.	sec.	D	November. gr.	mi.	se.	D	December. gr.	mi.	se.
1	19	11	45	1	18	48	58	1	18	48	46	1	18	21	14	1	19	26	7	1	19	55	36
2	20	8	52	2	19	46	36	2	19	47	20	2	19	20	53	2	20	26	46	2	20	56	50
3	21	6	0	3	20	44	15	3	20	45	56	3	20	20	33	3	21	27	27	3	21	58	5
4	22	3	9	4	21	41	56	4	21	44	33	4	21	20	16	4	22	28	10	4	22	59	21
5	23	0	18	5	22	39	39	5	22	43	13	5	22	20	0	5	23	28	55	5	24	0	37
6	23	57	28	6	23	37	23	6	23	41	55	6	23	19	48	6	24	29	41	6	25	1	54
7	24	54	38	7	24	35	8	7	24	40	39	7	24	19	37	7	25	30	28	7	26	3	11
8	25	51	49	8	25	32	56	8	25	39	25	8	25	19	28	8	26	31	17	8	27	4	29
9	26	49	1	9	26	30	45	9	26	38	14	9	26	19	22	9	27	32	7	9	28	5	47
10	27	46	13	10	27	28	35	10	27	37	5	10	27	19	18	10	28	32	59	10	29	7	5
11	28	43	26	11	28	26	27	11	28	35	58	11	28	19	17	11	29	33	52	11	♍	8	24
12	29	40	40	12	29	24	21	12	29	34	53	12	29	19	17	12	♎	34	47	12	1	9	43
13	♌	37	55	13	♍	22	17	13	♎	33	50	13	♏	19	19	13	1	35	43	13	2	11	2
14	1	35	11	14	1	20	14	14	1	32	49	14	1	19	23	14	2	36	40	14	3	12	21
15	2	32	27	15	2	18	14	15	2	31	51	15	2	19	29	15	3	37	39	15	4	13	40
16	3	29	45	16	3	16	15	16	3	30	54	16	3	19	37	16	4	38	39	16	5	14	59
17	4	27	4	17	4	14	17	17	4	30	0	17	4	19	47	17	5	39	40	17	6	16	18
18	5	24	23	18	5	12	21	18	5	29	8	18	5	20	0	18	6	40	42	18	7	17	37
19	6	21	44	19	6	10	28	19	6	28	19	19	6	20	14	19	7	41	45	19	8	18	56
20	7	19	5	20	7	8	37	20	7	27	32	20	7	20	30	20	8	42	50	20	9	20	14
21	8	16	28	21	8	6	47	21	8	26	47	21	8	20	48	21	9	43	55	21	10	21	33
22	9	13	52	22	9	4	59	22	9	26	4	22	9	21	8	22	10	45	1	22	11	22	51
23	10	11	17	23	10	3	13	23	10	25	23	23	10	21	30	23	11	46	9	23	12	24	9
24	11	8	43	24	11	1	29	24	11	24	44	24	11	21	54	24	12	47	17	24	13	25	27
25	12	6	10	25	11	59	46	25	12	24	7	25	12	22	19	25	13	48	26	25	14	26	44
26	13	3	39	26	12	58	5	26	13	23	32	26	13	22	47	26	14	49	36	26	15	28	1
27	14	1	9	27	13	56	27	27	14	23	0	27	14	23	16	27	15	50	47	27	16	29	18
28	14	58	40	28	14	54	50	28	15	22	30	28	15	23	46	28	16	51	58	28	17	30	35
29	15	56	12	29	15	53	16	29	16	22	3	29	16	24	19	29	17	53	10	29	18	31	51
30	16	53	46	30	16	51	44	30	17	21	37	30	17	24	53	30	18	54	23	30	19	33	7
31	17	51	21	31	17	50	14					31	18	25	29					31	20	34	22

CHAP. XXVI.

The uſe of theſe Ephemerides.

OF the uſe of theſe Ephemerides, becauſe they be altogether of the ſame forme, that others generally are, and have bin heretofore: and to be uſed alſo in all points after the ſame manner, for finding out by them the true place of the Sun at any time deſired, for ſo many years as they ſerve: I think it needleſs for me in this place to make any further mention: it being my purpoſe in this book, rather to make ſupplie of that is wanting in others, then to meddle with that which is by them ſufficiently handled and already publiſhed. This notwithſtanding I thought good to advertiſe the Reader, that theſe Ephemerides, though they be made for five years only, yet may profitably ſerve for many years to come after this manner: Subtract 1612 out of the year of Chriſt given, divide that remaineth by four; if any thing remain after diviſion made, it ſheweth which of the three common years in theſe Ephemerides anſwereth to the year given: if nothing remain, the fourth year is anſwerable to the year given. Then ſeek out the moneth and day of the time given both in theſe Ephemerides for that year, and in the Table of their Equations; and out of them take both the place of the Sun, and the Equation anſwerable to that moneth and day: for the product of this Equation by the quotient, added to the ſaid place of the Sun, if the number of the year given be more then 1612; or ſubtracted, if it be leſs, ſhall give you the true place of the Sun for the time given.

As for example, the 1 of *July* 1620. ſuppoſe you would know the place of the Sun: Subtracting therfore 1612 out of 1620, the remainder is 8, which being divided by 4, the quotient is 2, and nothing remaining; which ſheweth that the fourth year (*viz.* 1612) anſwereth to the year given. Alſo the ſaid moneth and day ſought out in theſe Ephemerides, and in the Table of their Equations, give you the place of the Sun 19 degr. 11 min. 45 ſec. of *Cancer*; and the Equation 1 min. 45 ſeconds which multiplied by the quotient 2, make 3 min. 30 ſec. And this added to the ſaid place of the Sun the 1 of *July* 1612, ſheweth you the true place of the Sun, for the time given, to be 19 degr. 15 min. and 15 ſec. of *Cancer*.

CHAP. XXVII.

The making of the Table of the Suns Declination.

THE place of the Sun being thus easily known by these Ephemerides for every day of five years, the Declinations of the Sun for every day of the same years were easily found out of the former Table of the Declination of every minute of the Ecliptick, in such sort as was shewed in the use of that Table before set down, chap. 18 pag. 116. and 117: And so was made with no less facility the Table following, of the Suns Declination for every day of five years together, commonly called by Sea-men, *A Regiment of the Sun.* For although it hath been thought sufficient in books of Navigation hitherto published, to make the Regiment of the Sun, or the Table of the Suns Declination for every day of 4 years, beginning with the first year after the leap year, and ending with the next Leap year, because the Declinations of the Sun for the 4 years following have bin supposed to be the same, in a manner that they were the 4 years before; and so to continue alike, without any notable difference for many years: yet to bring this matter to some more certainty, I have to this Table of Declination prefixed the fift year also, viz. the leap year going before the first of the said common years; that by comparing the Declinations of both leap years together it might the better appear what difference of Declination there is in every 4 years: by addition or subtraction of which difference, to the Declinations set down in this Table, this Table may be made to serve for a great many years yet to come, as truly as if it were made of purpose for them.

And for the more ease and readier use of all Sea-men, I have to this end gathered into this little Table, the differences of the Suns Declinations for every day of the first and last years, set down in this Table of the Suns Declinations here following; which differences may be called the Prosthaphæreses, or Equations of the Suns Declination; because that by adding them to, or subtracting them from the Declinations contained in this Table, the true Declination of the Sun for any day (though many years hence) may easily be found; and that after this manner.

Out of the number of the year of Christ given, subtract 1612; divide the remainder by four, and set aside the quotient; if any thing remain, that remainder sheweth in which of the 3 com-

mon

mon years you are to seek the Suns Declination: if nothing remain, you must look the Suns Declination in the fourth and last year, which is leap yeare. Then seek the moneth and day of the time given, both in that year so found in the Table of the Suns Declination, and also in this little Table of Prosthaphæreses of the Suns Declination, here immediatly following; taking out of that the Suns Declination, and out of this little Table the Equation of that Declination for four years; which Equation you shall multiply by the said quotient, and add the product to the Declination found in the Table, in the Spring and Autumn; that is, if the Sun be in *Aries*, *Taurus*, *Gemini*, *Libra*, *Scorpio*, or *Sagittarie*; or subtract it in Summer and winter, *viz.* the Sun being in *Cancer*, *Leo*, *Virgo*, *Capricorn*, *Aquarie*, or *Pisces*; for so shall you have the Suns true Declination for the time given.

Take for example the 15 of *March* in the year of Christ 1630: out of this subtract 1612, the remainder is 18; which being divided by 4, the quotient is also 4, and 2, remain; which sheweth that you must seek the Suns Declination in the second year after the leap year for the moneth and day aforesaid. Therefore I find the Suns Declination in that year (*viz.* 1610) to be 1 degr. 54 min. 16 sec. and in this little Table of Prosthaphæreses his difference of Declination for 4 years, 44 sec. which multiplied by the foresaid quotient 4, make 2 min. 56 sec. to be added to the said Declination 1 degr. 54 min 16 sec. that so you may have the true Declination of the Sun for that time, *viz.* 1 degr. 57 min. 12 sec.

Take also the 30 of August, in the year of our Lord 1659; out of which, if you subtract 1612, there shall remain 47; which being divided by 4, the quotient will be 11, and 3 remaining. I find therefore in the Table of the Suns Declination in the third year, for the moneth and day aforesaid, the Suns Declination 5 degr 29 min. 35 sec. Also in this little Table of Prosthaphæreses of the Suns Declination, I find for the same moneth and day, the difference of the Declination of the Sun for 4 years, to be 42 sec. which multiplied by the quotient 11, make the product 7 min. 42 sec. which subtracted out of the Declination aforesaid 5 degr. 29 min. 35 seconds, shall leave you the Suns true Declination for the 30 of *August* 1659, 5 degr. 21 min. 53 sec.

Day.	Ia Se.	Fe. Se.	M Se.	A. Se.	M Se.	Jn Se.	Jn Se	A. Se.	Se. Se.	O. Se.	N Se.	D. Se.
1	17	36	42	40	28	8	15	33	42	41	30	9
2	18	37	43	39	28	7	15	34	43	42	29	8
3	19	37	43	40	27	6	16	35	43	42	29	7
4	20	38	44	40	27	5	17	35	43	42	28	6
5	20	37	44	39	26	4	18	34	43	41	28	5
6	21	37	43	39	25	4	19	35	43	41	28	4
7	21	38	43	38	25	3	19	35	44	41	27	3
8	22	39	43	38	24	2	19	35	43	40	26	2
9	24	38	44	38	23	2	20	36	44	40	25	1
10	24	39	45	37	23	1	21	36	43	40	24	1
11	25	39	44	37	22	0	21	37	43	40	24	0
12	25	40	44	37	22	1	22	38	43	39	23	0
13	26	41	43	37	21	1	22	38	43	39	22	1
14	26	40	44	37	20	2	23	38	44	38	21	2
15	27	41	44	35	20	3	23	38	43	38	21	3
16	28	42	43	35	19	4	24	39	44	37	20	4
17	28	41	42	35	19	4	25	39	43	38	20	5
18	29	41	43	35	18	5	26	39	43	37	19	6
19	30	41	43	34	17	6	26	39	43	37	18	7
20	31	42	42	34	17	7	27	40	43	36	17	8
21	31	42	43	33	16	8	27	40	43	36	16	9
22	32	42	43	33	15	8	28	41	44	35	16	10
23	32	43	43	32	14	9	29	40	43	35	15	11
24	32	43	42	32	14	10	29	41	42	34	14	12
25	33	44	42	31	12	11	30	41	43	34	13	12
26	33	44	41	31	12	12	30	41	42	33	13	13
27	34	43	41	30	11	13	30	41	42	34	12	14
28	35	43	41	29	11	13	31	42	42	33	11	15
29	35	43	41	29	9	14	31	41	43	32	11	16
30	35	—	41	29	9	14	32	42	42	32	10	16
31	36		41		8		33	42		31		17

D	Jan. decl gr.	mi.	s.	differ mi.	se
1	21	54	39	9	35
2	21	45	4	9	59
3	21	35	5	10	24
4	21	24	41	10	54
5	21	13	45	11	7
6	21	2	38	11	37
7	20	51	1	12	2
8	20	38	59	12	24
9	20	26	35	12	48
10	20	13	47	13	10
11	20	0	37	13	34
12	19	47	3	13	54
13	19	33	9	14	17
14	19	18	52	14	24
15	19	4	28	15	12
16	18	49	16	15	33
17	18	33	43	15	26
18	18	18	17	15	59
19	18	2	18	16	18
20	17	46	0	16	38
21	17	29	22	16	55
22	17	12	27	17	14
23	16	55	13	17	31
24	16	37	42	17	49
25	16	19	53	18	6
26	16	1	47	18	21
27	15	43	26	18	38
28	15	24	48	18	54
29	15	5	54	19	9
30	14	46	45	19	23
31	14	27	22	19	38

D	Feb. decl gr.	mi.	s.	differ mi.	se
1	14	7	44	20	11
2	13	47	33	19	45
3	13	27	48	21	18
4	13	6	30	20	52
5	12	46	38	20	23
6	12	26	15	20	54
7	12	5	21	21	6
8	11	44	15	21	18
9	11	22	57	21	27
10	11	1	30	21	39
11	10	39	51	21	47
12	10	18	4	21	56
13	9	56	8	22	7
14	9	34	1	22	14
15	9	11	47	22	22
16	8	49	25	22	31
17	8	26	54	22	37
18	8	4	17	22	45
19	7	41	32	22	50
20	7	18	42	22	58
21	6	55	44	23	3
22	6	32	41	23	8
23	6	9	33	23	13
24	5	46	20	23	17
25	5	23	3	23	22
26	4	59	41	23	27
27	4	36	14	23	28
28	4	12	46	23	32
29	3	49	14	23	36

D	Mar. decl gr.	mi	se.	differ mi.	se
1	3	25	38	23	36
2	3	2	2	23	38
3	2	38	24	23	41
4	2	14	43	23	41
5	1	51	2	23	43
6	1	27	19	23	43
7	1	3	36	23	43
8	0	39	53	23	42
9	0	16	11	23	42
10	0	7	31	23	42
11	0	31	13	23	39
12	0	54	52	23	39
13	1	18	31	23	36
14	1	42	7	23	34
15	2	5	41	23	31
16	2	29	12	23	28
17	2	52	40	23	24
18	3	16	4	23	20
19	3	39	24	23	16
20	4	2	40	23	12
21	4	25	52	23	7
22	4	48	59	23	2
23	5	12	1	22	58
24	5	34	59	22	50
25	5	57	49	22	45
26	6	20	34	22	37
27	6	43	11	22	31
28	7	5	42	22	24
29	7	28	6	22	16
30	7	50	22	22	8
31	8	12	30	22	1

D	Apr. decl gr	mi.	se.	differ mi.	se
1	8	34	21	21	52
2	8	56	23	21	42
3	9	18	5	21	33
4	9	39	38	21	25
5	10	1	3	21	14
6	10	22	17	21	4
7	10	43	21	20	53
8	11	4	14	20	36
9	11	24	50	20	38
10	11	45	28	20	20
11	12	5	48	20	8
12	12	25	56	19	56
13	12	45	52	18	43
14	13	4	35	20	31
15	13	25	6	19	18
16	13	44	24	19	4
17	14	3	28	18	50
18	14	22	18	18	37
19	14	40	55	18	22
20	14	59	17	18	9
21	15	17	26	17	50
22	15	35	16	17	38
23	15	52	54	17	20
24	16	10	14	17	6
25	16	27	20	16	49
26	16	44	9	16	33
27	17	0	42	16	16
28	17	16	58	15	58
29	17	32	56	15	41
30	17	48	37	15	24

D	Ma. decl gr.	mi.	se.	differ mi	se
1	18	4	1	15	5
2	18	19	6	14	48
3	18	33	54	14	28
4	18	48	22	14	10
5	19	2	32	13	51
6	19	16	23	13	21
7	19	29	54	13	12
8	19	43	6	12	52
9	19	55	58	12	35
10	20	8	33	12	8
11	20	20	41	11	49
12	20	32	30	11	30
13	20	44	0	11	9
14	20	55	9	10	8
15	21	6	7	10	14
16	21	16	21	10	3
17	21	26	24	10	42
18	21	36	6	9	19
19	21	45	25	8	57
20	21	54	22	8	34
21	22	2	56	8	12
22	22	11	8	7	48
23	22	18	56	7	25
24	22	26	21	7	3
25	22	33	24	9	48
26	22	40	2	6	15
27	22	46	17	5	50
28	22	52	7	5	28
29	22	57	35	5	3
30	23	2	38	4	39
31	23	7	17	4	15

D	Ju decl. gr.	m.	se	Diff. mi.	se
1	23	11	32	3	50
2	23	15	22	3	26
3	23	18	48	3	1
4	23	21	49	2	38
5	23	24	27	1	12
6	23	25	39	2	47
7	23	28	26	1	23
8	23	29	49	0	58
9	23	30	47	0	34
10	23	31	21	0	9
11	23	31	30	0	16
12	23	31	14	0	42
13	23	30	32	1	5
14	23	29	27	1	29
15	23	27	58	1	56
16	23	26	2	2	19
17	23	23	43	2	44
18	23	20	59	3	2
19	23	17	57	3	39
20	23	14	18	3	57
21	23	10	21	3	22
22	23	4	59	3	45
23	23	1	14	5	10
24	22	56	4	5	33
25	22	50	31	5	57
26	22	44	34	6	19
27	22	38	15	6	45
28	22	31	30	7	8
29	22	24	22	7	3
30	22	16	51	7	53

D	Ju decl gr.	mi.	se	Diff. mi.	se
1	22	8	57	8	10
2	22	0	42	8	39
3	21	52	3	9	2
4	21	43	1	9	23
5	21	33	38	9	45
6	21	23	53	10	8
7	21	13	45	10	29
8	21	3	16	10	50
9	20	52	26	11	10
10	20	41	16	11	33
11	20	29	43	11	53
12	20	17	50	12	13
13	20	5	37	12	34
14	19	53	3	12	53
15	19	40	10	13	12
16	19	26	58	13	33
17	19	13	25	13	51
18	18	59	34	14	10
19	18	45	24	14	28
20	18	30	56	14	47
21	18	16	9	15	6
22	18	1	3	15	22
23	17	45	41	15	40
24	17	30	1	15	57
25	17	14	4	16	14
26	16	57	50	16	31
27	16	41	19	16	46
28	16	24	33	17	3
29	16	7	30	17	18
30	15	50	12	17	33
31	15	32	39	17	49

D	Au decl gr.	mi	se.	Diff. mi.	se.
1	15	14	50	18	3
2	14	56	47	18	17
3	14	38	30	18	32
4	14	19	58	18	47
5	14	1	11	18	58
6	13	42	13	19	13
7	13	23	0	19	24
8	13	3	36	19	38
9	12	43	58	19	50
10	12	24	8	20	1
11	12	4	7	20	13
12	11	43	54	20	25
13	11	23	29	20	36
14	11	2	53	20	46
15	10	42	7	20	56
16	10	21	11	21	6
17	10	0	5	21	17
18	9	38	48	21	25
19	9	17	23	21	34
20	8	55	59	21	44
21	8	34	5	21	54
22	8	12	14	22	0
23	7	50	14	22	7
24	7	28	7	22	15
25	7	5	52	22	21
26	6	43	31	22	28
27	6	21	3	22	33
28	5	58	30	22	43
29	5	35	47	22	49
30	5	13	1	22	52
31	4	50	9	22	58

D	Sep. decl. gr.	mi.	se.	Diff. mi.	se.
1	4	27	11	23	1
2	4	4	10		6
3	3	41	4		10
4	3	17	54		14
5	2	54	40		18
6	2	31	22		20
7	2	8	2	23	23
8	1	44	39		26
9	1	21	13		28
10	0	57	45		30
11	0	34	15		30
12	0	10	45		32
13	0	12	47		32
14	0	36	19		33
15	0	59	52		33
16	1	23	25		33
17	1	46	58		31
18	2	10	29		31
19	2	34	0		29
20	2	57	29		28
21	3	20	57		25
22	3	44	22		23
23	4	7	55		20
24	4	31	5		16
25	4	54	21		13
26	5	17	34		9
27	5	40	43		5
28	6	3	48	22	59
29	6	26	47		55
30	6	49	42		50

D	Oct. Decl. gr.	mi.	sec	Diff. mi.	se.
1	7	12	32	22	43
2	7	35	15	22	37
3	7	57	52	22	30
4	8	20	22	22	23
5	8	42	45	22	16
6	9	5	1	22	8
7	9	27	9	22	0
8	9	49	9	21	52
9	10	11	1	21	42
10	10	32	43	21	33
11	10	54	16	21	24
12	11	15	40	21	13
13	11	36	53	21	3
14	11	57	56	20	51
15	12	18	47	20	40
16	12	39	27	20	27
17	12	59	54	20	17
18	13	20	11	20	3
19	13	40	14	19	50
20	14	0	4	19	37
21	14	19	41	19	23
22	14	39	4	19	7
23	14	58	11	18	55
24	15	17	6	18	38
25	15	35	44	18	23
26	15	54	7	18	6
27	16	12	13	17	51
28	16	30	4	17	34
29	16	47	38	17	16
30	17	4	54	16	59
31	17	21	53	16	41

D	No. decl. gr.	mi.	se.	Diff. mi.	se.
1	17	38	34	16	23
2	17	54	57	16	3
3	18	11	0	15	55
4	18	26	55	15	14
5	18	42	9	15	5
6	18	57	14	14	44
7	19	11	58	14	23
8	19	26	21	14	3
9	19	40	24	13	41
10	19	54	5	13	18
11	20	7	23	12	56
12	20	20	19	12	24
13	20	32	43	12	21
14	20	45	4	11	47
15	20	56	51	11	24
16	21	8	15	10	59
17	21	19	14	10	35
18	21	29	49	10	12
19	21	40	1	9	44
20	21	49	45	9	21
21	21	59	6	8	53
22	22	7	59	8	29
23	22	16	28	8	3
24	22	24	31	7	2
25	22	32	0	7	17
26	22	39	17	6	43
27	22	46	0	6	16
28	22	52	16	5	48
29	22	58	4	5	21
30	23	3	25	4	55

D	Dec. decl. gr.	m.	sec	diffe. mi.	se.
1	23	8	20	4	25
2	23	12	45	3	58
3	23	16	43	3	30
4	23	20	13	3	2
5	23	23	15	2	33
6	23	25	48	2	6
7	23	27	54	1	36
8	23	29	30	1	9
9	23	30	49	0	39
10	23	31	18	0	12
11	23	31	30	0	18
12	23	31	12	0	46
13	23	30	26	1	14
14	23	29	12	1	43
15	23	27	29	2	11
16	23	25	18	2	40
17	23	22	38	3	8
18	23	19	30	3	36
19	23	15	54	4	4
20	23	11	50	4	32
21	23	7	18	5	1
22	23	2	17	5	28
23	22	56	49	5	54
24	22	50	55	6	23
25	22	44	32	6	50
26	22	37	42	7	17
27	22	30	25	7	43
28	22	22	42	8	4
29	22	14	32	8	10
30	22	5	56	9	36
31	21	56	54	9	2

First year. 1609.

D	Jan. decl. gr.	m.	se.	diff. mi	se
1	21	47	27	9	54
2	21	37	33	10	19
3	21	27	14	10	43
4	21	16	31	11	7
5	21	5	24	11	33
6	20	53	51	11	55
7	20	41	56	12	19
8	20	29	37	12	41
9	20	16	56	13	6
10	20	3	50	13	27
11	19	50	23	13	49
12	19	36	34	14	13
13	19	22	21	14	31
14	19	7	50	14	54
15	18	52	56	15	15
16	18	37	41	15	35
17	18	22	6	15	53
18	18	6	13	16	15
19	17	49	58	16	31
20	17	33	27	16	52
21	17	16	35	17	9
22	16	59	26	17	28
23	16	41	58	17	44
24	16	24	14	18	2
25	16	6	12	18	18
26	15	47	54	18	34
27	15	29	20	18	50
28	15	10	30	19	5
29	14	51	25	19	19
30	14	32	6	19	35
31	14	12	31	19	48

D	Feb. decl. gr.	mi.	se.	Diff. mi.	se.
1	13	52	43	20	2
2	13	32	41	20	15
3	13	12	26	20	28
4	12	51	58	20	40
5	12	31	18	20	52
6	12	10	26	21	3
7	11	49	23	21	15
8	11	28	8	21	26
9	11	6	42	21	35
10	10	45	7	21	45
11	10	23	22	21	55
12	10	1	27	22	4
13	9	39	23	22	12
14	9	17	11	22	20
15	8	54	51	22	29
16	8	32	22	22	35
17	8	9	47	22	43
18	7	47	4	22	50
19	7	24	14	22	55
20	7	1	19	23	25
21	6	37	54	22	44
22	6	15	10	23	12
23	5	51	58	23	16
24	5	28	42	23	21
25	5	5	21	23	25
26	4	41	56	23	29
27	4	18	27	23	31
28	3	54	56	23	34

D	Mar. decl. gr.	mi.	se.	diffe. mi	se
1	3	31	22	23	36
2	3	7	46	23	39
3	2	44	7	23	40
4	2	20	27	23	41
5	1	56	46	23	43
6	1	33	3	23	42
7	1	9	21	23	43
8	0	45	38	23	43
9	0	21	55	23	42
10	0	1	47	23	42
11	0	25	29	23	39
12	0	49	8	23	39
13	1	12	47	23	37
14	1	36	24	23	34
15	1	59	58	23	32
16	2	23	30	23	29
17	2	46	59	23	25
18	3	10	24	23	21
19	3	33	45	23	17
20	3	57	2	23	14
21	4	20	16	23	8
22	4	43	24	23	3
23	5	6	27	22	58
24	5	29	25	22	52
25	5	52	17	22	47
26	6	15	4	22	38
27	6	37	42	22	34
28	7	0	16	22	24
29	7	22	40	22	19
30	7	44	59	22	10
31	8	7	9	22	2

D	Apr. decl. gr.	mi.	se.	diffe. mi	se
1	8	29	11	21	54
2	8	51	5	21	46
3	9	12	51	21	35
4	9	34	26	21	27
5	9	55	53	21	16
6	10	17	9	21	7
7	10	38	16	20	56
8	10	59	12	20	44
9	11	19	56	20	34
10	11	40	30	20	23
11	12	0	53	20	11
12	12	21	4	19	59
13	12	41	3	19	47
14	13	0	50	19	34
15	13	20	24	19	20
16	13	39	44	19	8
17	13	58	52	18	54
18	14	17	46	18	39
19	14	36	25	18	26
20	14	54	51	18	11
21	15	13	2	17	51
22	15	30	53	17	47
23	15	48	38	17	26
24	16	6	4	17	9
25	16	23	13	16	53
26	16	40	6	16	37
27	16	56	43	16	20
28	17	13	3	16	2
29	17	29	5	15	46
30	17	44	51	14	32

Ma. decl		diff.		Iu. decli		diff.		Jul decl		diff.		Au. decl		diff.	
D	gr.	mi.	se.	mi.	s.	gr.	mi.	se	ni.	se	D	gr. mi	se.	mi.	se
1	18	0	23	15	6	1	23	10	32	3	57	1	22	10	55	8	11
2	18	15	29	14	52	2	23	14	39	3	31	2	22	2	44	8	34
3	18	30	21	14	33	3	25	18	0	3	8	3	21	54	10	8	56
4	18	44	54	14	16	4	23	21	8	2	43	4	21	45	14	9	17
5	18	59	10	13	53	5	23	23	51	2	18	5	21	35	57	9	40
6	19	13	3	13	37	6	23	25	9	2	63	6	21	26	17	10	2
7	19	26	40	13	16	7	23	28	2	1	29	7	21	16	15	10	24
8	19	39	56	12	57	8	23	29	31	1	4	8	21	5	51	10	45
9	19	52	53	12	36	9	23	30	35	0	40	9	20	55	6	11	6
10	20	5	29	12	16	10	23	31	15	0	15	10	20	44	0	11	29
11	20	17	45	11	55	11	23	31	30	0	10	11	20	32	31	11	47
12	20	29	47	11	35	12	23	31	20	0	35	12	20	20	44	12	6
13	20	41	15	11	13	13	23	30	45	1	0	13	20	8	38	12	30
14	20	52	28	10	52	14	23	29	45	1	24	14	19	56	8	12	48
15	21	3	20	10	32	15	23	28	21	2	49	15	19	43	20	13	9
16	21	13	52	10	9	16	23	25	32	1	13	16	19	30	11	13	27
17	21	24	1	9	47	17	23	24	19	2	30	17	19	16	44	13	47
18	21	33	48	9	24	18	23	21	41	3	2	18	19	2	57	14	5
19	21	43	12	9	2	19	23	18	39	3	28	19	18	48	52	14	24
20	21	52	14	8	41	20	23	15	11	3	50	20	18	34	20	14	42
21	22	0	55	8	18	21	23	11	21	4	12	21	18	19	46	15	1
22	22	9	11	7	55	22	23	7	9	5	44	22	18	4	45	15	19
23	22	17	6	7	30	23	23	2	25	5	3	23	17	49	20	15	36
24	22	24	36	7	7	24	22	57	22	5	28	24	17	33	50	15	52
25	22	31	43	6	45	25	22	51	54	5	53	25	17	17	58	16	19
26	22	38	28	6	20	26	22	46	3	6	14	26	17	1	48	16	36
27	22	44	48	5	57	27	22	39	49	6	40	27	16	45	21	16	52
28	22	50	45	5	32	28	22	33	9	7	1	28	16	28	38	16	58
29	22	56	17	5	9	29	22	26	8	7	25	29	16	11	40	17	15
30	23	1	26	4	46	30	22	18	43	7	48	30	15	54	25	17	29
31	23	6	12	4	20							31	15	36	50	17	45

Sep. decl.		Diff.		Oct. decl		Diff		Nov. dec		diff.		Dec. decl		diff.	
D	gr.	mi.	se	mi.	se	D	gr.	mi.	se.	mi.	se	D	gr.	mi.	se.	mi.	se
1	4	32	46	23	1	1	7	7	0	22	45	1	17	34	33	16	28
2	4	9	45		5	2	7	29	45	22	39	2	17	51	1	16	7
3	3	46	40		9	3	7	52	24		31	3	18	7	8	15	50
4	3	23	31		14	4	8	14	55		25	4	18	38	58	15	29
5	3	0	17		16	5	8	37	20		19	5	18	53	37	14	48
6	2	37	1		20	6	8	59	39		9	6	19	8	25	14	29
7	2	13	41		22	7	9	21	48		2	7	19	22	54	14	7
8	1	50	19		25	8	9	43	51	21	53	8	19	37	1	13	46
9	1	26	54		27	9	10	5	44	21	45	9	19	50	47	13	24
10	1	3	27		29	10	10	27	29	21	35	10	20	4	11	13	2
11	0	39	58	23	31	11	10	49	4	21	26	11	20	17	13	12	39
12	0	16	27		32	12	11	10	30	21	16	12	20	29	52	12	10
13	0	7	5		32	13	11	31	46	21	5	13	20	42	8	11	53
14	0	30	37		33	14	11	52	51	20	54	14	20	54	1	11	30
15	0	54	10		33	15	12	13	45	20	43	15	21	5	31	11	5
16	1	17	43		31	16	12	34	28	20	30	16	21	16	36	10	42
17	1	41	14		33	17	12	54	58	20	19	17	21	27	1	10	16
18	2	4	47		31	18	13	15	17	20	7	18	21	37	34	9	52
19	2	28	18	23	30	19	13	35	24	19	53	19	21	47	26	9	23
20	2	51	48		28	20	13	55	17	19	40	20	21	56	51	9	1
21	3	15	16		26	21	14	14	57	19	23	21	22	5	52	8	36
22	3	38	42		23	22	14	34	23	19	12	22	22	14	20	8	8
23	4	2	5		21	23	14	53	35	18	57	23	22	22	36	7	43
24	4	25	26		17	24	15	12	32	18	42	24	22	30	19	7	10
25	4	48	43		14	25	15	31	14	18	27	25	22	37	35	6	50
26	5	11	57		10	26	15	49	41	18	10	26	22	44	25	6	23
27	5	35	7		5	27	16	7	51	17	55	27	22	50	40	5	54
28	5	58	12	23	1	28	16	25	46	17	38	28	22	56	42	5	26
29	6	21	13		56	29	16	43	24	17	21	29	23	2	8	5	2
30	6	44	9	22	1	30	17	0	45	17	3	30					
						31	17	17	48	16	45						

Dec. decl		diff.	
D	gr.	mi.	se.
1	23	7	10
2		11	43
3		15	48
4		19	25
5		22	34
6		25	14
7		27	26
8		29	10
9		30	24
10	23	31	12
11		31	30
12		31	19
13		30	40
14		29	33
15		27	57
16		25	53
17		23	19
18	23	20	18
19		16	49
20		12	52
21		8	26
22		3	32
23	22	58	12
24	22	52	23
25		46	7
26		39	24
27		32	14
28		24	37
29	22	16	33
30		8	4
31	21	59	8

Jan. decl		diff.	
D	gr. mi. se.	mi	se
1	21 49 46	9	48
2	21 39 58	10	11
3	21 29 47	10	38
4	21 19 9	11	1
5	21 8 8	11	26
6	20 56 42	11	50
7	20 44 52	12	14
8	20 32 38	12	36
9	20 20 2	12	59
10	20 7 3	13	23
11	19 53 40	13	44
12	19 39 56	14	6
13	19 25 50	14	29
14	19 11 21	14	47
15	18 56 34	15	5
16	18 41 29	15	29
17	18 25 56	15	51
18	18 10 5	16	8
19	17 53 57	16	29
20	17 37 28	16	46
21	17 20 42	17	0
22	17 3 36	17	22
23	16 46 14	17	41
24	16 28 33	17	58
25	16 10 35	18	13
26	15 52 22	18	31
27	15 33 51	18	45
28	15 15 6	19	2
29	14 56 4	19	16
30	14 36 48	19	31
31	14 17 17	19	45

Feb. decl		diff.	
D	gr. mi. sec	mi.	se
1	13 57 32	19	59
2	13 37 33	20	11
3	13 17 22	20	25
4	12 56 57	20	37
5	12 36 20	20	49
6	12 15 31	21	1
7	11 54 30	21	11
8	11 33 19	21	24
9	11 11 55	21	32
10	10 50 23	21	54
11	10 28 29	21	42
12	10 6 47	22	1
13	9 44 46	22	11
14	9 22 35	22	19
15	9 0 16	22	26
16	8 37 50	22	35
17	8 15 15	22	41
18	7 52 34	22	48
19	7 29 46	22	54
20	7 6 52	23	0
21	6 43 52	23	5
22	6 20 47	23	11
23	5 57 36	23	16
24	5 34 20	23	20
25	5 11 0	23	4
26	4 47 56	23	47
27	4 24 9	23	30
28	4 0 39	23	34

Mar. dec		diff.	
D	gr. mi. se.	mi	s
1	3 37 5	23	36
2	3 13 29	23	38
3	2 49 51	23	40
4	2 26 11		41
5	2 2 30		41
6	1 38 49		43
7	1 15 6		43
8	0 51 23		43
9	0 27 30		42
10	0 3 58		41
11	0 19 43		41
12	0 43 24		39
13	1 7 3		38
14	1 30 41		35
15	1 54 16	23	32
16	2 17 48		29
17	2 41 17		27
18	3 4 44		22
19	3 28 6		18
20	3 51 24		26
21	4 14 50	23	58
22	4 37 48		4
23	5 0 52		0
24	5 23 52	22	53
25	5 46 45	22	48
26	6 9 33	22	41
27	6 32 14		34
28	6 54 48		27
29	7 17 15		20
30	7 39 35		13
31	8 1 48		44

Apr. decl		diff.	
D	gr. mi. se.	mi.	se.
1	8 23 52	21	56
2	8 45 48	21	46
3	9 7 34	21	39
4	9 29 13	21	28
5	9 50 41	21	20
6	10 12 1	21	9
7	10 33 10	20	58
8	10 54 8	20	47
9	11 14 55	20	37
10	11 35 32	20	26
11	11 55 58	20	14
12	12 16 12	20	2
13	12 36 14	19	49
14	12 56 3	19	38
15	13 15 41	19	24
16	13 35 5	19	10
17	13 54 15	18	57
18	14 13 12	18	43
19	14 31 55	18	30
20	14 50 25	18	14
21	15 8 39	17	59
22	15 26 38	17	44
23	15 44 22	17	29
24	16 1 51	17	14
25	16 19 5	16	57
26	16 36 2	16	41
27	16 52 43	16	24
28	17 9 7	16	7
29	17 25 14	16	49
30	17 41 3	15	33

May. dec		diffe.	
D	gr. mi. se	mi.	se.
1	17 56 36	15	14
2	18 11 50	15	6
3	18 26 56	14	30
4	18 41 26	14	17
5	18 55 43	14	0
6	19 9 43	13	41
7	19 23 24	13	21
8	19 36 45	13	1
9	19 49 46	12	41
10	20 2 27	12	22
11	20 14 49	12	1
12	20 26 50	11	38
13	20 38 28	11	19
14	20 49 47	10	57
15	21 0 44	10	37
16	21 11 21	10	14
17	21 21 35	10	2
18	21 31 37	9	20
19	21 40 57	8	59
20	21 49 56	8	55
21	21 58 51	8	22
22	22 7 13	8	0
23	22 15 13	7	35
24	22 22 48	7	14
25	22 30 2	6	49
26	22 36 51	6	27
27	22 43 18	6	2
28	22 49 20	5	39
29	22 54 59	5	15
30	23 0 14	4	51
31	23 5 5	4	26

Jun. decl		Diff.	
D	gr. mi. s.	mi.	se
1	23 9 31	4	2
2	23 13 33	3	38
3	17 11	3	13
4	20 24	2	50
5	23 14	2	24
6	25 38	1	59
7	27 37	1	35
8	29 12	1	10
9	30 22	0	46
10	31 8	0	21
11	31 29	0	4
12	23 31 25	0	29
13	30 56	0	54
14	30 2	1	18
15	28 44	1	43
16	27 1	2	7
17	24 54	2	33
18	22 21	2	56
19	19 25	3	21
20	16 4	3	46
21	12 18	4	9
22	23 8 9	4	34
23	23 3 35	4	57
24	22 58 38	5	22
25	53 16	5	45
26	47 31	6	9
27	41 22	6	34
28	34 48	6	56
29	27 52	7	20
30	20 32	7	42

Iul. decli		Diffe	
D	gr. mi se	mi.	se.
1	22 12 50	8	5
2	22 4 45	8	28
3	21 56 17	8	51
4	21 47 26	9	13
5	21 38 13	9	34
6	21 28 39	9	57
7	21 18 42	10	18
8	21 8 24	10	40
9	20 57 44	11	1
10	20 46 43	11	22
11	20 35 21	10	52
12	20 24 29	12	54
13	20 11 35	12	24
14	19 59 11	12	44
15	19 46 27	13	7
16	19 33 20	13	18
17	19 20 2	13	43
18	19 6 19	14	1
19	18 52 18	14	19
20	18 37 59	14	38
21	18 23 21	14	57
22	18 8 24	15	13
23	17 53 11	15	32
24	17 37 39	15	49
25	17 21 50	16	6
26	17 5 44	16	22
27	16 49 22	16	40
28	16 32 42	16	54
29	16 15 48	17	11
30	15 58 37	17	26
31	15 41 11	17	41

Aug. dec		Diff.	
D	gr. mi. se.	mi.	se
1	15 23 30	17	56
2	15 5 34	18	12
3	14 47 22	18	24
4	14 28 58	18	39
5	14 10 19	18	53
6	13 51 26	19	6
7	13 32 20	19	18
8	13 13 2	19	32
9	12 53 30	19	44
10	12 33 46	20	16
11	12 13 30	19	48
12	11 53 41	20	17
13	11 33 24	20	33
14	11 12 53	20	48
15	10 52 13	20	52
16	10 31 21	21	2
17	10 10 19	21	11
18	9 49 8	21	21
19	9 27 47	21	30
20	9 6 17	21	39
21	8 44 38	21	48
22	8 22 50	21	56
23	8 0 54	22	2
24	7 38 52	22	12
25	7 16 40	22	17
26	6 54 23	22	26
27	6 31 57	22	31
28	6 9 36	22	39
29	5 46 47	22	43
30	5 24 4	22	50
31	5 1 14	22	55

D	Sep. decl. gr.	mi.	se.	diff. mi.	se.
1	4	38	19	22	59
2	4	15	20	23	4
3	3	52	16		8
4	3	29	8		12
5	3	5	56		16
6	2	42	40		19
7	2	19	21	23	22
8	1	55	59		24
9	1	32	35		27
10	1	9	8		29
11	0	45	39		30
12	0	22	9		32
13	0	1	23		32
14	0	24	55		32
15	0	48	27		33
16	1	12	0		33
17	1	35	33		32
18	1	59	5		32
19	2	22	37		29
20	2	46	6		29
21	3	9	35		26
22	3	33	1		25
23	3	56	26		21
24	4	19	47		18
25	4	43	5		14
26	5	6	19		11
27	5	29	30		7
28	5	52	37		3
29	6	15	40	22	56
30	6	38	36		53

D	Oct. Decl gr.	mi.	sec	Diff. mi.	se.
1	7	1	29	22	47
2	7	24	16	22	39
3	7	46	55	22	34
4	8	9	29	22	26
5	8	31	55	22	20
6	8	54	15	22	12
7	9	16	27	22	3
8	9	38	30	21	57
9	10	0	27	21	46
10	10	22	13	21	38
11	10	43	51	21	28
12	11	5	19	21	18
13	11	26	37	21	8
14	11	47	45	20	57
15	12	8	42	20	45
16	12	29	27	20	34
17	12	50	1	20	21
18	13	9	22	20	10
19	13	30	32	19	57
20	13	50	29	19	43
21	14	10	12	19	30
22	14	29	42	19	15
23	14	48	57	19	1
24	15	7	58	18	56
25	15	26	44	18	30
26	15	45	14	18	15
27	16	3	29	17	59
28	16	21	28	17	41
29	16	39	9	17	25
30	16	56	34	17	7
31	17	13	41	16	50

D	Nov. dec. gr.	mi.	sec	diffe. mi.	se.
1	17	30	31	16	32
2	17	47	3	16	13
3	18	3	16	15	53
4	18	19	9	15	34
5	18	34	43	15	15
6	18	49	58	14	55
7	19	4	53	14	32
8	19	19	25	14	13
9	19	33	38	13	51
10	19	47	29	13	30
11	20	0	59	13	7
12	20	14	6	12	45
13	20	26	51	12	21
14	20	39	12	12	10
15	20	51	22	11	24
16	21	2	46	11	12
17	21	13	58	10	46
18	21	24	44	10	23
19	21	35	7	9	57
20	21	45	4	9	33
21	21	54	37	9	7
22	22	3	44	8	41
23	22	12	25	8	15
24	22	20	40	7	50
25	22	28	30	7	23
26	22	35	53	6	55
27	22	42	48	6	29
28	22	49	17	6	2
29	22	55	19	5	34
30	23	0	53	4	7

D	Dec. decl gr.	m	se.	diff. mi.	se
1	23	5	0	5	40
2	23	10	40	4	11
3	23	14	51	3	44
4	23	18	35	3	15
5	23	21	50	2	48
6	23	24	38	2	18
7	23	26	56	1	51
8	23	28	47	1	22
9	23	30	9	0	54
10	23	31	3	0	25
11	23	31	28	0	4
12	23	31	24	0	32
13	23	30	52	1	1
14	23	29	51	1	28
15	23	28	23	2	58
16	23	25	25	1	25
17	23	24	2	2	7
18	23	21	5	3	23
19	23	17	42	3	50
20	23	13	52	4	19
21	23	9	33	4	47
22	23	4	46	5	14
23	22	59	32	5	42
24	22	53	50	6	10
25	22	47	40	6	36
26	22	41	4	7	4
27	22	34	0	7	30
28	22	26	30	7	57
29	22	18	33	8	23
30	22	10	10	8	50
31	22	1	20	9	16

D	Jan. decl. gr.	mi.	se.	diff. mi.	se
1	21	52	4	9	41
2	21	42	23	10	6
3	21	32	17	10	31
4	21	21	46	10	56
5	21	10	50	11	20
6	20	59	30	11	44
7	20	47	46	12	8
8	20	35	38	12	31
9	20	23	7	12	54
10	20	10	13	13	16
11	19	56	57	13	39
12	19	43	18	14	1
13	19	29	17	14	22
14	19	14	55	14	44
15	19	0	11	15	4
16	18	45	7	15	25
17	18	29	42	15	45
18	18	13	57	16	4
19	17	57	53	16	24
20	17	41	29	16	42
21	17	24	47	17	1
22	17	7	46	17	17
23	16	50	29	17	37
24	16	32	52	17	53
25	16	14	59	18	10
26	15	56	49	18	26
27	15	38	22	18	42
28	15	19	40	18	58
29	15	0	42	19	13
30	14	41	29	19	27
31	14	22	2	19	42

D	Feb. decl gr.	mi.	e.	diff. mi	se
1	14	2	20	19	55
2	13	42	25	20	9
3	13	22	16	20	21
4	13	1	55	20	35
5	12	41	20	20	45
6	12	20	35	20	58
7	11	59	37	21	10
8	11	38	27	21	27
9	11	17	0	21	23
10	10	55	37	21	41
11	10	33	56	21	50
12	10	12	6	22	0
13	9	50	6	22	7
14	9	27	59	22	17
15	9	5	42	22	25
16	8	43	17	22	32
17	8	20	45	22	40
18	7	58	5	22	46
19	7	35	19	22	52
20	7	12	26	22	59
21	6	49	27	23	4
22	6	26	23		10
23	6	3	13		14
24	5	39	59		19
25	5	16	40		23
26	4	53	17		26
27	4	29	51		30
28	4	6	21		33
29					
30					
31					

D	Mar. dec gr.	mi.	se	diffe. mi	se
1	3	42	48	23	35
2	3	19	13	23	38
3	2	55	35	23	39
4	2	31	56		41
5	2	8	15		42
6	1	44	33		42
7	1	20	51		43
8	0	57	8		45
9	0	33	25		42
10	0	9	43	23	42
11	0	13	59		41
12	0	37	40		39
13	1	1	19		38
14	1	24	57		36
15	1	48	33		33
16	2	12	6		30
17	2	35	36	23	27
18	2	59	3		24
19	3	22	27		19
20	3	45	46		15
21	4	9	1		10
22	4	32	11		6
23	4	55	17		1
24	5	18	18	22	55
25	5	41	13	22	49
26	6	4	2		42
27	6	26	44		37
28	6	49	21		28
29	7	11	49		22
30	7	34	11		14
31	7	56	25		6

D	Apr. decl gr.	mi.	se.	diffe mi.	se
1	8	18	31	21	58
2	8	40	29	21	49
3	9	2	18	21	41
4	9	23	59	21	31
5	9	45	30	21	21
6	10	6	51	21	12
7	10	28	3	21	1
8	10	49	4	20	50
9	11	9	54	20	40
10	11	30	34	20	28
11	11	51	2	20	16
12	12	11	18	20	6
13	12	31	24	19	52
14	12	51	16	19	40
15	13	9	56	19	27
16	13	30	23	19	15
17	13	49	38	19	0
18	14	8	38	18	47
19	14	27	25	18	32
20	14	45	57	18	18
21	15	4	15	18	3
22	15	22	18	17	48
23	15	40	6	17	33
24	15	57	39	17	17
25	16	14	56	17	1
26	16	31	57	16	45
27	16	48	42	16	28
28	17	5	10	16	11
29	17	21	21	15	54
30	17	37	15	15	36

Third year. 1611.

Ma. decl		diff.	
D	gr. mi. se.	mi. se.	
1	17 52 51	15	19
2	18 8 10	15	1
3	18 23 11	14	42
4	18 37 53	14	23
5	18 52 16	14	5
6	19 6 21	13	45
7	19 20 6	13	26
8	19 33 32	13	6
9	19 46 38	12	47
10	19 59 25	12	26
11	20 11 51	12	5
12	20 23 56	11	45
13	20 35 41	11	23
14	20 47 4	11	4
15	20 58 8	10	41
16	21 8 49	10	19
17	21 19 8	9	58
18	21 29 6	9	35
19	21 38 41	9	4
20	21 47 45	9	0
21	21 56 45	8	28
22	22 5 13	8	6
23	22 13 19	7	41
24	22 21 0	7	19
25	22 28 19	6	55
26	22 35 14	6	33
27	22 41 47	6	8
28	22 47 55	5	44
29	22 53 39	5	21
30	22 59 0	4	56
31	23 3 56	4	33

Ju. decli.		diff.	
D	gr. mi. se	mi	se
1	23 8 29	4	8
2	23 12 37	3	43
3	23 16 20	3	20
4	23 19 40	2	55
5	23 22 35	2	30
6	23 25 5	2	5
7	23 27 10	1	41
8	23 28 51	1	16
9	23 30 7	0	52
10	23 30 59	0	27
11	23 31 26	0	2
12	23 31 28	0	23
13	23 31 5	0	48
14	23 30 17	1	11
15	23 29 0	1	40
16	23 27 20	1	59
17	23 25 27	2	26
18	23 23 1	2	51
19	23 20 10	3	15
20	23 16 55	3	39
21	23 13 16	4	4
22	23 9 12	4	29
23	23 4 43	4	51
24	22 59 52	5	16
25	22 54 36	5	40
26	22 48 56	5	2
27	22 42 54	6	20
28	22 36 26	6	51
29	22 29 35	7	14
30	22 22 21	7	37

Jul. dec		diff.	
D	gr. mi. se.	mi. se	
1	22 14 44	7	59
2	22 6 45	8	23
3	21 58 23	8	46
4	21 49 37	9	7
5	21 40 30	9	30
6	21 31 0	9	51
7	21 21 9	10	13
8	21 10 56	10	35
9	21 0 21	10	56
10	20 49 25	11	17
11	20 38 8	11	38
12	20 26 30	11	58
13	20 14 32	12	18
14	20 2 14	12	40
15	19 49 34	12	58
16	19 36 36	13	18
17	19 23 18	13	37
18	19 9 41	13	57
19	18 55 44	14	15
20	18 41 29	14	34
21	18 26 55	14	52
22	18 12 3	15	9
23	17 56 54	15	29
24	17 41 25	15	43
25	17 25 42	16	2
26	17 9 40	16	19
27	16 53 21	16	34
28	16 36 47	16	51
29	16 19 56	17	8
30	16 2 48	17	22
31	15 45 26	17	38

Au. decl		diff.	
D	gr. mi. se	mi. s.	
1	15 27 48	17	52
2	15 9 56	18	7
3	14 51 49	18	22
4	14 33 27	18	35
5	14 14 52	18	50
6	13 56 2	19	3
7	13 36 59	19	15
8	13 17 44	19	29
9	12 58 15	19	40
10	12 38 35	19	54
11	12 18 41	20	4
12	11 58 37	20	17
13	11 38 20	20	27
14	11 17 53	20	39
15	10 57 14	20	49
16	10 36 25	20	59
17	10 15 26	21	9
18	9 54 17	21	19
19	9 32 58	21	29
20	9 11 31	21	38
21	8 49 53	21	45
22	8 28 8	21	53
23	8 6 15	22	2
24	7 44 13	22	9
25	7 22 4		17
26	6 59 47		23
27	6 37 23		30
28	6 14 54		32
29	5 52 17	22	47
30	5 29 30		48
31	5 6 42		54

Sep decl		Diff.	
D	gr. mi se	mi se	
1	4 43 53	22	58
2	4 20 55	23	3
3	3 57 52		7
4	3 34 45		11
5	3 11 34		15
6	2 48 19		19
7	2 25 0		21
8	2 1 39		24
9	1 38 15		26
10	1 14 49		28
11	0 51 21	23	31
12	0 27 50		31
13	0 4 19		32
14	0 19 13		32
15	0 42 45		33
16	1 6 18		32
17	1 29 50		33
18	1 53 23		32
19	2 16 55	23	30
20	2 40 25		28
21	3 3 53		28
22	3 27 13		32
23	3 50 45		22
24	4 14 7		19
25	4 37 26		16
26	5 0 42		12
27	5 23 54		7
28	5 47 1	23	3
29	6 10 4	22	59
30	6 33 3	22	54

Oct. decl		Diff	
D	gr. mi. se.	mi. se	
1	6 55 57	22	48
2	7 18 45	22	41
3	7 41 26		37
4	8 4 3		27
5	8 26 30		21
6	8 48 51		51
7	9 10 42		29
8	9 33 11	21	58
9	9 55 9	21	49
10	10 16 58	21	39
11	10 38 37	21	31
12	11 0 8	21	20
13	11 21 28	21	10
14	11 42 38	21	0
15	12 3 36	20	48
16	12 24 26	20	37
17	12 45 3	20	25
18	13 5 28	20	12
19	13 25 40	20	0
20	13 45 40	19	46
21	14 5 26	19	34
22	14 25 0	19	19
23	14 44 19	19	4
24	15 3 23	18	49
25	15 22 12	18	34
26	15 40 46	18	19
27	15 59 5	18	3
28	16 17 8	17	46
29	16 34 54	17	29
30	16 52 23	17	12
31	17 9 35	16	53

Nov. dec d		diff.	
D	gr. mi se.	mi se	
1	17 26 28	16	36
2	17 43 4	16	13
3	17 59 22	15	58
4	18 15 20	15	37
5	18 30 57	15	22
6	18 46 19	14	57
7	19 1 16	14	40
8	19 15 56	14	18
9	19 30 14	13	56
10	19 44 10	13	35
11	19 57 45	13	12
12	20 10 57	13	50
13	20 24 47	11	28
14	20 36 15	12	4
15	20 48 19	11	41
16	21 0 0	11	17
17	21 11 17	10	53
18	21 22 10	10	23
19	21 32 38	10	4
20	21 42 42	9	38
21	21 52 22	9	14
22	22 1 34	8	47
23	22 10 21	8	22
24	22 18 43	7	55
25	22 26 38	7	29
26	22 34 7	7	3
27	22 41 10	6	35
28	22 47 45	6	9
29	22 53 54	5	41
30	22 59 35	5	13

Dec. dec		diff.	
D	gr. mi se	mi se	
1	23 4 48	4	47
2	23 9 35	4	18
3	23 13 53	3	50
4	23 17 43	3	23
5	23 21 6	2	53
6	23 23 59	1	28
7	23 25 25	2	58
8	23 28 23	1	28
9	23 29 51	1	1
10	23 30 52	0	32
11	23 31 24	0	4
12	23 31 28	0	25
13	23 31 3	0	54
14	23 30 9	1	22
15	23 28 47	1	51
16	23 26 56	2	19
17	23 24 37	2	47
18	23 21 50	3	16
19	23 18 34	3	44
20	23 14 50	4	11
21	23 10 39	4	41
22	23 5 58	5	1
23	23 0 57	5	42
24	22 55 15	6	3
25	22 49 12	6	30
26	22 42 42	6	56
27	22 35 46	7	24
28	22 28 22	7	52
29	22 20 30	8	16
30	22 12 14	8	44
31	22 3 30	9	8

Jan. decl		differ		Feb. decl		differ		Mar. decl		differ		Apr. decl		differ	
D	gr.	mi	ſ.	gr.	mi.	ſ	mi	gr.	mi	ſe.	mi.	gr	mi	ſe	mi.
1	21	54	22	9	36	1	14	7	8	19	52	1	3	24	56	23	37	1	8	35	11	21	51
2	21	44	46	9	59	2	13	47	16	20	5	2	3	1	19	24	3	2	8	57	2	21	43
3	21	34	47	10	26	3	13	27	11	21	13	3	2	37	10	23	17	3	9	18	45	21	33
4	21	24	21	10	50	4	13	5	52	19	31	4	2	13	59	23	41	4	9	40	18	21	24
5	21	13	31	11	14	5	12	40	21	20	43	5	1	50	18	23	42	5	10	1	42	21	14
6	21	2	17	11	3	6	12	25	38	20	53	6	1	26	36	23	43	6	10	22	56	21	3
7	20	51	14	12	37	7	12	4	43	21	7	7	1	2	53	23	43	7	10	43	59	20	53
8	20	38	37	12	26	8	11	43	36	21	17	8	0	39	10	23	43	8	11	4	52	20	42
9	20	26	11	12	48	9	11	22	19	21	28	9	0	15	27	23	44	9	11	25	34	20	31
10	20	13	23	13	11	10	11	0	51	21	35	10	0	8	17	23	39	10	11	46	5	20	20
11	20	0	12	13	34	11	10	39	12	21	41	11	0	31	56	23	40	11	12	6	25	20	8
12	19	46	38	13	55	12	10	17	24	21	57	12	0	55	36	23	38	12	12	26	35	19	56
13	19	32	43	14	17	13	9	55	27	22	8	13	1	19	14	23	27	13	12	46	29	19	43
14	19	18	26	14	39	14	9	33	21	22	15	14	1	42	41	23	43	14	13	0	12	19	29
15	19	3	47	14	59	15	9	11	6	22	23	15	2	6	24	23	31	15	13	25	41	19	18
16	18	48	48	15	20	61	8	48	43	22	30	16	2	29	55	23	27	16	13	44	59	19	4
17	18	33	28	15	40	17	8	26	13	22	37	17	2	53	22	23	25	17	14	4	3	18	50
18	18	17	48	16	0	18	8	3	36	22	45	18	3	16	47	23	20	18	14	22	55	18	36
19	18	1	48	16	19	19	7	40	51	22	52	19	3	40	7	23	15	19	14	41	29	18	22
20	17	45	29	16	37	20	7	17	59	22	57	20	4	3	22	23	13	20	14	59	51	18	6
21	17	28	5	16	57	21	6	55	2	23	49	21	4	26	35	23	7	21	15	17	57	17	52
22	17	11	55	17	14	22	6	31	13	22	22	22	4	49	42	23	2	22	15	35	49	17	36
23	16	54	41	17	31	23	6	8	51	23	13	23	5	12	44	22	56	23	15	53	25	17	21
24	16	37	10	17	51	24	5	45	38	23	19	24	5	35	40	22	51	24	16	10	40	17	5
25	16	19	20	18	6	25	5	22	19	23	22	25	5	58	31	22	44	25	16	27	51	16	49
26	16	1	14	18	22	26	4	58	57	23	25	26	6	21	15	22	37	26	16	44	42	16	32
27	15	42	52	18	39	27	4	35	42	23	29	27	6	43	52	22	31	27	17	1	12	16	15
28	15	24	13	18	54	28	4	12	3	23	32	28	7	6	23	22	24	28	17	17	27	15	58
29	15	5	19	19	9	29	3	48	31	23	35	29	7	28	47	22	16	29	17	33	25	15	41
30	14	46	10	19	24							30	7	51	3	22	8	30	17	49	6	15	23
31	14	26	46	19	38							31	8	13	11	22	0						

Ma. decl		differ		Ju. decl.		Diff.		Ju. decl.		Diff.		Au. decl.		Diff.	
D	gr.	mi.	ſe.	mi	ſc	D	gr.	m.	ſ	mi	ſe	D	gr.	mi	ſe.	mi	ſ.
1	18	4	29	15	5	1	23	11	40	3	49	1	22	8	43	8	17	1	15	14	18	18	5
2	18	19	34	14	47	2	23	15	2	3	25	2	22	0	26	8	39	2	14	56	13	16	18
3	18	34	21	14	25	3	23	18	54	3	0	3	21	51	47	9	3	3	14	37	55	18	32
4	18	48	42	13	9	4	23	21	54	2	37	4	21	42	44	9	24	4	14	19	23	18	46
5	19	2	58	13	50	5	23	24	31	2	11	5	21	33	20	9	46	5	14	0	37	18	59
6	19	16	48	13	31	6	23	26	42	1	48	6	21	23	34	10	8	6	13	41	38	19	13
7	19	30	19	13	11	7	23	28	30	1	21	7	21	13	26	10	29	7	13	22	25	19	26
8	19	43	30	12	51	8	23	29	51	0	58	8	21	2	57	10	51	8	13	2	59	19	37
9	19	56	21	12	31	9	23	30	45	0	33	9	20	52	6	11	11	9	12	43	22	19	50
10	20	8	52	12	10	10	23	31	22	0	8	10	20	40	55	11	33	10	12	23	32	20	2
11	20	21	2	11	50	11	23	31	30	0	17	11	20	29	23	11	55	11	12	3	30	20	14
12	20	32	52	11	29	12	23	31	13	0	42	12	20	17	27	12	13	12	11	43	16	20	25
13	20	44	21	11	8	13	23	30	31	1	6	13	20	5	14	12	34	13	11	22	51	20	36
14	20	55	29	10	46	14	23	29	25	1	31	14	19	52	40	12	53	14	11	2	15	20	46
15	21	6	15	10	22	15	23	27	54	1	55	15	19	39	47	13	13	15	10	41	29	20	57
16	21	16	37	10	6	16	23	25	59	2	20	16	19	26	34	13	34	16	10	20	32	21	3
17	21	26	43	9	40	17	23	23	39	2	45	17	19	13	0	13	52	17	9	59	29	21	20
18	21	36	23	9	10	18	23	20	54	3	10	18	18	59	8	14	10	18	9	38	19	21	25
19	21	45	33	9	6	19	23	17	44	3	33	19	18	44	58	14	29	19	9	16	44	21	35
20	21	54	39	8	33	20	23	14	11	3	57	20	18	30	20	14	40	20	8	55	9	21	44
21	22	3	12	8	11	21	23	10	13	4	22	21	18	15	41	15	5	21	8	33	25	21	52
22	22	11	23	7	47	22	23	5	51	4	46	22	18	0	55	15	24	22	8	11	33	21	59
23	22	19	10	7	25	23	23	1	5	5	10	23	17	45	12	15	40	23	7	49	34	22	8
24	22	26	35	7	1	24	22	55	55	5	35	24	17	29	32	15	58	24	7	27	26	22	15
25	22	33	36	6	38	25	22	50	20	5	55	25	17	13	34	16	14	25	7	5	11	22	21
26	22	40	14	6	14	26	22	44	24	6	22	26	16	57	20	16	31	26	6	42	50	22	28
27	22	46	28	5	50	27	22	38	2	6	45	27	16	40	49	16	47	27	6	20	22	22	35
28	22	52	18	5	26	28	22	31	17	7	9	28	16	24	2	17	3	28	5	57	47	22	41
29	22	57	44	5	3	29	22	24	8	7	31	29	16	6	59	17	19	29	5	35	6	22	47
30	23	2	47	4	38	30	22	16	37	7	54	30	15	49	42	17	34	30	5	12	19	22	52
31	23	7	25	4	15							31	15	32	6	17	48	31	4	49	27	22	58

D	Sep. decl. gr.	mi.	sec	diff. mi.	se.
1	4	26	29	23	2
2	4	3	27		6
3	3	40	21		10
4	3	17	11		14
5	2	53	57		18
6	2	30	39		21
7	2	7	18		22
8	1	43	56		27
9	1	20	29		27
10	0	57	2		29
11	0	33	33		31
12	0	10	2		32
13	0	13	30		33
14	0	37	3		32
15	1	0	35	23	34
16	1	24	9		32
17	1	47	41		31
18	2	11	12		31
19	2	34	43		29
20	2	58	12		28
21	3	21	40		26
22	3	45	6		22
23	4	8	28		19
24	4	31	47		17
25	4	55	4		12
26	5	18	16		9
27	5	41	25	23	5
28	6	4	30		0
29	6	27	30	22	54
30	6	50	24	22	49

D	Oct. decl. gr.	mi.	se	Diff. mi.	se.
1	7	13	13	22	44
2	7	35	57		34
3	7	58	34		30
4	8	21	4		22
5	8	43	26		17
6	9	5	43		8
7	9	27	51	21	58
8	9	49	49		52
9	10	11	41		42
10	10	33	23		33
11	10	54	56	21	23
12	11	16	19		13
13	11	37	32		2
14	11	58	34	20	51
15	12	19	25		39
16	12	40	4		28
17	13	0	32		16
18	13	20	48	20	3
19	13	40	51	19	49
20	14	0	40	19	36
21	14	20	16	19	23
22	14	39	39	19	8
23	14	58	47	18	53
24	15	17	40	18	38
25	15	36	18	18	22
26	15	54	40	18	7
27	16	12	47	17	50
28	16	30	37	17	33
29	16	48	10	17	16
30	17	5	26	16	58
31	17	22	24	16	41

D	No. decl. gr.	mi.	se.	diff. mi.	se
1	17	39	5	16	21
2	17	55	26	16	3
3	18	11	29	15	44
4	18	27	13	15	24
5	18	42	37	15	3
6	18	57	40	14	45
7	19	12	25	14	23
8	19	26	48	14	1
9	19	40	49	13	40
10	19	54	29	13	18
11	20	7	47	12	55
12	20	20	42	12	34
13	20	33	16	12	9
14	20	45	25	11	48
15	20	57	12	11	23
16	21	8	35	10	59
17	21	19	34	10	34
18	21	30	8	10	9
19	21	40	17	9	46
20	21	50	3	9	19
21	21	59	22	8	53
22	22	8	15	8	28
23	22	16	43	8	2
24		24	45	7	36
25		32	21	7	9
26		39	30	6	42
27		46	12	6	15
28		52	27	5	48
29		58	15	5	20
30	23	3	35	4	53

D	Dec. decl. gr.	m.	sec	Diff. mi.	se
1	23	8	28	4	25
2		12	53	3	57
3		16	50	3	29
4		20	19	3	1
5		23	20	2	33
6		25	53	2	4
7		27	57	1	45
8		29	32	1	8
9		30	40	0	39
10		31	19	0	11
11		31	30	0	18
12		31	12	0	48
13		30	24	1	14
14		29	10	1	44
15		27	26	2	13
16		25	13	2	40
17		22	33	3	9
18		19	24	3	37
19		15	47	4	5
20		11	42	4	34
21		7	8	5	0
22		2	8	5	29
23	22	56	39	5	56
24		50	43	6	23
25		44	20	6	51
26		37	29	7	10
27		30	19	7	52
28		22	27	8	11
29		14	16	8	36
30		5	40	9	3
31	21	56	37	9	26

CHAP.

CHAP. XXVIII.

The use of the former Table, or regiment of the Sun.

THis Table of the Suns declinations, as it differeth nothing in form from others that have been publiſhed heretofore: ſo likewiſe the manner of uſing it, is altogether the ſame that hath been accuſtomed in former Tables of this kind, ſaving that I muſt give warning of one error that hath been committed herein; which is (as I have obſerved) that ſome of our Sea-men do take the Suns declination out of their regiments, without any æquation by addition or ſubtraction of the part proportional, agreeable to the difference of Longitude of the place where they are, as if they were alwayes at the ſame place, or under the ſame meridian, for which their Regiments were made; for which cauſe alone, (though they avoid all other errors, it may ſo fall out, that they may be deceived ſometimes 10, or 12. minutes (or more in a long voyage) in taking the Suns declination. For there is not any Table of the Suns declination, but that it muſt needs be made for ſome one meridian (as this former Table was made for the meridian of *London*) and therefore cannot be truely uſed in any other, without ſome Equation anſwerable to the diſtance of the meridians or difference of Longitude.

To avoid this error therefore, firſt learn how much you differ in Longitude from the place for which your Table was made, (and though you miſſe half a dozen, or half a ſcore degrees herein, it cannot in this point breed any ſenſible error.) Secondly, take out the difference of the Suns declination, agreable to the ſpace of 24. hours, about the time of your obſervation. Thirdly, as 360. is to this difference of declination; ſo is the difference of Longitude to the part proportional, or Equation of the declination; which Equation is to be added to the declination of the day of obſervation, if the declination of the Sun be either increaſing, and the place of obſervation weſtward; or elſe decreaſing, and the place of obſervation eaſtwards from the place for which your Table of declination was made: otherwiſe this Equation is to be ſubtracted from the declination of your day of obſervation, that you may have the true declination of the Sun, for the time and place of your obſervation.

But if the time of your obſervation be the noon-tide immediately before or after the Suns entrance into either of the æquinoctial

points,

points, you must follow another rule, and that is this: divide the difference of Longitude by 15, mark how many unites the quotient conteineth, and so many minutes adde to the Declination found in the former Table, if you be either Eastward from the Meridian of *London* and observe the noontide before the *Equinoctium*: or if you be Westward from that Meridian and, observe the noontide after the *Equinoctium*; for the sum shall be the Declination desired. Otherwise, if you be either Westward from the Meridian of *London*, and observe the noontide next before the *Equinoctium*, or Eastward from that Meridian, and Observe the day immediatly after the *Equinoctium*, compare the Declination found in the Table with the foresaid quotient, and subtract the lesser out of the greater, for that remaineth is the Declination desired: Which Declination hath the same denomination of North or South that the Table sheweth, if the quotient be lesse then the Declination found in the Table: but if the quotient be greater the denomination must be altered from North to South, or from South to North, contrary to that the Table sheweth. If the quotient be equal to the Declination found in the former Table, the Sun is in the very Equinoctial point, and hath no Declination at all.

A few examples will make these rules more plain: suppose therefore the 30 of March 1610. you were sailing in the bay of *Mexico*, differing in Longitude to the Westwards from the Meridian of *London*, about 90 degrees by estimation: the Declination of the Sun for that day found in the former Table, is 7 degrees, 39 minutes, 35 seconds, the difference of the declination in 24 hours at that time 22 minutes, 13 seconds. Now as 360 is to 22 minutes, 13 seconds; so is 90 degrees, to 5 minutes, 33 seconds, (the part proportional or equation desired) which because the Declination increaseth, and the bay of *Mexico* is also Westward from the Meridian of *London*, must be added to the Declination before found in the Table, and so shall you have the true Declination of the Sun that day at noon for that place, 7 degr. 45 min. 8 sec. But admit you had sailed Eastwards, and were in the *East Indian* Ocean sea, differing likewise in Longitude from *London* about 90 deg. therefore the difference of Declination, and the part proportional thereof, or equation of the Declination shall be the same they were before. But because you are gone so much Eastwards, the Sun commeth 6 hours sooner to your Meridian there, then it doth to ours here at *London*: and therefore because the Declination also is increasing, and will be

greater

greater when the Sun commeth to our Meridian then it was, the Sun being under the Meridian of the *East indies*, that equation of Declination must there be subtracted out of the Declination found in the Table, which before was to be added when we supposed you to be in the bay of *Mexico*, because the Sun commeth later by six hours to the Meridian of that place, then to ours; and therefore the Declination of the Sun increasing in the mean time, will be greater there then here.

Now imagine you sail in the year 1612 through the Streights of *Magellan*, and having passed over the South Sea, come the 12 of *September* to the *Philippinas*, differing in Longitude from *London* VVestwards about 210 degrees.

In this example, because the Sun is neer the Equinoctial point (altering his Declination about 24 min. in 24 hours, that is, for every houre one minute) therefore divide 210. (the difference of Longitude) by 15 (the number of degrees conteined in one hour) the Quotient will be 14 minutes (the difference of Declination answerable to that difference of Longitude) The Declination found in the Table for that day is 10 minutes, 2 seconds Northerly: which (Declination) because it decreaseth (the Sun not being yet come to the Equinoctial) must be subtracted out of 14. and there shall remain 3 min. 58 sec. the Declination of the Sun that day at noon, for that place. But this Declination is Southerly, because the Quotient 14 min. is greater then 10 min. 2 sec. the Declination found in the Table. It would be at this time too tedious for me further to exemplifie every particularity specified in the former Rules, which may cause some small diversitie in the use of the Suns Declination, having already given examples of the hardest cases that may befall herein, which if they be well considered, and especially compared with the Globe or Sphere, (wherein the whole manner of the Suns motion and Declinations may most easily, not onely be seen, but also felt as it were with the fingers ends) the reason and Demonstration of all those Rules, and of all the diversities of working therein specified, may most plainly appear to him that is but of a mean capacity.

CHAP. XXIX.

The Declinations of the principal fixed stars about the Equinoctial, corrected by Observation.

BUt because the Declination of the Sun is then only of good use for knowing the Latitude at Sea, when his Meridian Altitude

Altitude may be Observed : so as although all the rest of the day and night be fair and cleer, if a Cloud cover the Sun but one quarter of an hour only, about noon, your Tables of the Suns Declination will stand you in no stead: there have been therefore other means divised for attaining to the knowledge of the height of the Pole, not only in particular, by Observation of the Pole-star and Guards, but also in generall by the Meridian Altitude and Declination of any notable fixed star whatsoever. So as not in the day time alone, and that onely at noon, but almost at any time of the night, if any small portion of the heavens towards the North or South, appear but a small time cleer through the raking Clouds, the Latitude of the place where you are, may hereby bee more easily known, then by Observation of the Suns Meridian Altitude. For to omit the changing of the Suns Declination from North to South; and from South to North twice in every year, which notwithstanding breedeth some diversity of working (by neglect whereof some have grossly erred) the Sun by reason of his swiftness of motion, increaseth or diminisheth his Declination dayly, yea hourly, and that very sensibly many times, whereof there must needs arise many severall considerations to be had of the right use and application of the Suns Declination found in the Table, as well in respect of the part of Declination, (whether it be North or South) as also in regard of the difference of Longitude between the place, for which the Tables of the Suns Declination were made, and the place of Observator, whether it be Easterly or VVesterly from thence, besides many other particularities lately related, and needlesse here to be repeated. But the fixed stars mooving so excee dingslowly, that in more then 70 years, they go not so much as one degree in there proper motion from the west Eastwards, keep not only the same part of the North, or South, but almost the same point and minute of Declination for many years together, I mean those stars especialy that are placed in the signs of *Gemini*, *Cancer*, *Sagittarie*, or *Capricorne*, neer the Solstitiall Colure, which in an hundred years or two, can alter their Declination scarce one minute: whereas those stars that bee in *Pisces*, *Aries*, *Virgo*, or *Libra*, especialy if they be neer the Equinoctial colure, may differ in there Declinations about one minute in 3 years; which difference, though it be something, yet for a dozen or twenty years, will hardly be so much as can at Sea be Observed by any Instrument hitherto had in use there.

For these two causes therefore (that is, for the more easie and generall use of the Declinations of the fixed stars then of the Sun) I wish they were more generally known and

obſerved by our ſea-men then they are, as whereby they might not onely moſt eaſily know the elevation of the Pole at any time of the night, but alſo in any place of the world, much more commodiouſly then otherwiſe they can, becauſe that in what latitude, and how far ſoever they ſhould come either Northwards or Southwards, they might alwayes have their choice of divers fixed ſtars neer the meridian, both towards the North and South, of a convenient height to be obſerved. But herewith it were alſo to be wiſhed, that the tables of the fixed ſtars declinations, which are moſt common amongſt Engliſh Mariners had been more free from errour then they are; I mean, eſpecially the Tables publiſhed in *Bourns* regiment, and *Normans* new Attractive, which (tables agreeing almoſt in every tittle one with another) ſeem to be taken word for word one out of another, errours and all; ſo as you cannot finde any errour in the one, but you ſhall be ſure alſo to have the ſame in the other: notwithſtanding ſome of thoſe errours are more then two or three whole degrees, (which becauſe being neglected, or unknown to the Mariner that ſhall uſe thoſe tables) they may bring him in greater danger then many a hidden rock under ſea: I have therefore by diligent obſervation, with a quadrant of more then ſix foot ſemidiameter, detected and corrected thoſe errours, ſhewing not onely the truth to be heedfully followed, but thoſe errours alſo to be as carefully avoided, in ſuch ſort as is ſet down in the Table following, wherein the firſt colnmn containeth the names of the ſtars; the ſecond, the true declinations (as they were found by obſervation) in degrees and minutes, together with the part of declination, ſignified by the letters N and S, whereof N ſignifieth the declination to be North, and S South; the third column containeth the declinations publiſhed in *Bourns* and *Normans* tables; the fourth ſheweth the difference of theſe declinations from the truth; the fifth giveth the right aſcenſions of thoſe ſtars, reſolved into hours and minutes: in the ſixth and laſt column are ſet down the magnitudes or bigneſſe of the ſame ſtars.

The names of the Stars.	Declinat. by observa.			B. & N. Declin.		Difference.		Right Ascens.		Bigness
	Deg.	Min.		D.	M.	D	M	H.	M.	
Whales back	12	20	S	12	11		09	0	50	3
Whales belly	12	22	S	12	20		02	1	32	3
Rams horn	17	17	N	17	19		02	1	32	3
Rams head	21	33	N	21	16		17	1	46	3
Bulls eye	15	38	N	15	42		04	4	13	1
Orions left foot	08	43	S	09	14		29	4	55	1
Orions left shoulder	05	56	N	04	37	1	19	5	04	2
First in Orions girdle	00	38	S	01	19		41	5	12	2
Orions right shoulder	06	17	N	06	18		01	5	34	1
Great Dog	16	12	S	15	30		42	6	27	1
Lesser Dog	06	13	N	06	04		09	7	18	1
Brightest in Hydra	06	53	S	04	47	2	06	9	08	2
Lions heart	13	55	N	21	59		17	9	57	1
Lions neck	21	52	N	14	03		08	9	46	2
Lions back	22	43	N	22	30		13	10	52	2
Lions tail	16	50	N	16	46		04	11	29	1
Ravens head	20	45	S	19	53		52	11	50	3
Ravens wing	15	16	S	17	08	1	52	11	56	3
Virgins spike	09	00	S	08	53		07	13	05	1
Betwixt Bootes thighs	21	20	N	22	09		49	13	56	1
South Ballance	14	14	S	13	44		30	14	30	2
North Ballance	07	46	S	07	33		13	14	55	2
Scorpions heart	25	25	S	24	47		38	16	06	1
Hercules head	14	57	N	15	20		23	16	56	3
Serpentaries head	12	57	N	14	07	1	10	17	16	3
Eagles heart	17	54	N	17	28		26	19	32	2
Dolphins tail	10	00	N	10	01		01	20	16	3
Goats tail	17	51	S	14	13	3	38	21	27	3
Water powrers leg	18	10	S	15	52	2	18	22	35	3
Pegasus shoulder	12	58	N	13	01		03	22	46	2
Pegasus leg	25	58	N	26	30		32	22	44	2
Whales tail	20	12	S	21	47	1	35	00	24	3

Chap. XXX.
The use of the former Table.

THe declinations of the fixed ſtars conteined in this table, being to be uſed altogether after the ſame manner, as the declination of the Sun, for finding out the height of the Pole; it would be but needleſſe for me in this place, to write any more of the uſe thereof, being a thing ſo eaſie and ſo commonly known amongſt mariners, and already ſufficiently delivered by others.

Chap. XXXI.
The true diſtances of certain principal fixed Stars from the North Pole, found by late obſervation.

BUt ſeeing this former table conteineth almoſt no other ſtars, but ſuch as are betwixt the Tropicks, and neer about the Equinoctial circle, which are not ſo fit to be obſerved by them that ſail far Southwards, or under the burnt Zone (for there they will be too high above the Horizon) I thought good here to adjoyn another table of as many more principal fixed ſtars (heedfully obſerved alſo with the ſame quadrant) that are placed neer about the North Pole, which may ſtand you in as much ſtead, as twice ſo many taken out of other parts of the heavens, becauſe they come twice to the meridian above our horizon, in every 24 hours; ſo as in winter-time many of them may be obſerved both evening and morning, twice in one night, both above and beneath the Pole. Notwithſtanding, for them that ſail Northwards, it ſhall be beſt to obſerve theſe ſtars when they come to the meridian under the Pole. Contrariwiſe, they that travel far Southwards, may beſt obſerve their meridian altitudes above the Pole. Herein alſo this table differeth from the former; that whereas in the former were ſet down the declinations of the ſtars, or their diſtances from the Equinoctial; in this contrariwiſe are ſet down the complements of their declinations, or their diſtances from the Pole; whereby the height of the Pole may more eaſily be found, then by their declinations, onely by adding the height of the ſtarre obſerved beneath the Pole, to the diſtance thereof from the Pole: or by ſubtracting onely the diſtance of the ſtar from the Pole out of the Northerly meridian altitude, obſerved above the *Pole*.

But if the meridian altitude of the ſtar be ſoutherly (the ſtar obſerved being ſouthwards from the Zenith) ſubtract the height of the ſtar from 180, and out of the remainder ſubtract the diſtance of the ſtar from the Pole, ſo ſhall you have the height of the Poſe: thus alſo there would be a more eaſie way, then that is commonly uſed for knowing the latitude by the Sun or ſtars, having ſoutherly declination. For if inſtead thereof, the complement of declination were ſet down in the table; the height of the Sun or ſtars alwayes ſubtracted out of this complement, ſhould leave you the height of the Pole, or latitude deſired.

But to return to the table of fixed ſtars here following, the firſt column therein conteineth (as before) the names of the ſtars: the ſecond, their complements of declination, or diſtances from the Pole: the third column giveth you their right aſcenſions, reduced into hours and minutes of an hour: the fourth ſheweth their bigneſſe or magnitudes.

The

The names of the stars.	Distance from the Pole.		Right ascension.		Bigness.
	D.	M.	H.	M.	
In the breſt of Caſſiopeia	35	35	0	19	3
In her lip	31	26	0	32	3
The Pole-ſtar	02	52	0	50	3
At the knees of Caſſiopeia	31	50	1	00	3
In her leg	28	18	1	25	3
Perſeus right ſhoulder	38	05	2	35	3
Perſeus right ſide	41	38	2	56	2
The goat, or wagoners left ſhoulder	44	30	4	49	1
The wagoners right ſhoulder	45	11	5	30	2
The firſt in the great bears fore-foot	40	30	8	24	3
The ſecond in the ſame foot	41	28	8	32	3
In her former left knee	36	37	8	58	3
The great bears ſide	31	26	10	58	2
The great bears back	26	05	10	40	2
The end of the Dragons tail	18	26	11	08	3
The great bears thigh	34	03	11	32	2
The great bears rump	30	41	11	54	2
The next to the end of the Dragons tail	17	57	12	14	3
The firſt in the great bears tail next her	31	49	12	32	2
The middlemoſt in her tail (rump	32	55	13	06	2
In the end of her tail	38	37	13	32	2
The next before the turning of the Dra-	23	40	13	53	3
The formoſt guard (gons tail	14	11	14	54	2
In the turning of the Dragons tail	29	37	15	14	3
The hindmoſt guard	16	42	15	26	2
Next after the turning of the Dragons	30	20	15	54	3
The Dragons eye (tail	37	18	17	22	3
The Dragons head	38	22	17	44	3
In the Swans right wing	45	44	19	34	3
In her tail	46	06	20	30	2
Cepheus his right ſhoulder	29	00	21	10	3
The back of Caſſiopeia's chair	33	02	23	48	3

Chap. XXXII.

To know at what time any of the foresaid fixed stars come to the Meridian for any day of the year.

NOw because the fixed stars are then onely meet to be observed for finding the latitude, when they are in the meridian; it is therefore good for him that meaneth to observe them, to know at what time they come to the meridian. To this end there are tables published, and almost in every mariners hands, pretending to shew at what hour and minute every star in the first of these two former tables commeth to the meridian, for the beginning and midst of every moneth in the year, agreeing likewise in every errour one with another: but because these errours breed not (at any time) greater danger or damage to the Mariner that is ware of them, then to make him watch for their coming to the meridian, a quarter, or half an hour longer then otherwise he needed (this inconvenience onely provided for) those tables may serve the turn well enough, for them that list not trouble themselves to learn a better way.

But for them that are desirous of a more true and generall way, I have also made the table following of the Suns right ascensions, reduced into hours and minutes for every day of this present year 1599, according to the Ephemerides of the Sun, before set down; with help of which table it may easily be known for any day of any year in our age, at what time not onely any of the forelaid fixed stars about the Equinoctial, but those also about the Pole, or any other, (whose right ascensions are known in hours and minutes) come to the meridian, and that after this manner. Finde out in the table following the moneth and day wherein you observe; the moneth in the upper margine of the table, the day in the first column thereof next the left hand, the common meeting of the column descending from the moneth, and of the line proceeding from that day towards the right hand, shall give you the Suns right ascension in hours and minutes for the same day. This right ascension of the Sun, subtract alwayes out of the right ascension of the star, adding 24 hours to the stars right ascension, if it be lesse then the right ascension of the Sun: the remainder sheweth how many hours and minutes after noon the star cometh to the upper part of the meridian; which if they be more then 12 hours, subtract 12 from

from them, and the remainder ſhall ſhew you how many hours and minutes after midnight the ſtar cometh to the upper part of the meridian. The upper part of the meridian I call that which paſſeth from the Pole, by the Zenith to the Horizon ſouthwards. But it ſhall be needful alſo many times when you would obſerve the ſtars about the Pole (which never ſet) to know the time of their coming to the nether part of the meridian, which may eaſily be done, onely by adding 12 hours to the time of their coming to the upper part of the meridian, if it be leſſe then 12 hours, or by ſubtracting as much, if it be more.

Suppoſe for example, the 25 of February 1599, I would know the time of the great dogs coming to the meridian. Firſt therefore (in the next table) following the column deſcending from **February** downwards, and the line proceeding from the 25 day towards the right hand, in the common meeting of them both, I finde 23 hours, 10 min. the Suns right aſcenſion that day at noon. Then in the firſt table of fixed ſtars, I finde the great dogs right aſcenſion to be 6 degr. 27 min. to which (becauſe it is leſſe then the Suns right aſcenſion) I adde 24 hours, and the ſum of both cometh to 30 hours, 27 min. out of this I ſubtract the Suns right aſcenſion, 23 hours, 10 min. and there remais 7 hours, 17 min. the time of the great dogs coming to the upper part of the meridian in the afternoon.

Take one example alſo of a ſtar that never ſetteth: and admit the 20 of **December** the ſame year, you would know what time the formoſt Guard cometh to the Meridian beneath the Pole: Firſt therefore you ſhall finde, as before, the Suns right aſcenſion that day to be 18 hours, 36 min. and the right aſcenſion of that ſtar (in the ſecond table of fixed ſtars) 14 hours, 54 min. to which (being leſſe then the Suns right aſcenſion) adde 24 hours, and from the ſum (38 hours, 24 min.) ſubtract the Suns right aſcenſion 18 hours 36 min ſo there ſhall remain 20 hours 18 min. the time of the formoſt Guards coming to the upper part of the meridian, from which ſubtract 12, ſo you have the time when it cometh to the nether part of the meridian, 8 hours, 18 min. after noon.

A Table of the Suns Right Ascension in hours

	January		February		March		April		May		June	
D.	H.	M.	H.	M.	H.	M.	H.	M.	H.	M.	H.	M.
1	19	30	21	39	23	25	1	18	3	11	5	15
2	19	34	21	43	23	28	1	22	3	15	5	19
3	19	39	21	47	23	32	1	26	3	19	5	25
4	19	43	21	50	23	36	1	29	3	23	5	27
5	19	47	21	54	23	40	1	33	3	27	5	31
6	19	52	21	58	23	44	1	36	3	30	5	36
7	19	56	22	02	23	47	1	40	3	34	5	40
8	20	00	22	06	23	51	1	43	3	38	5	45
9	20	04	22	09	23	55	1	47	3	42	5	49
10	20	08	22	14	23	58	1	51	3	46	5	53
11	20	13	22	18	0	02	1	55	3	50	5	57
12	20	17	22	21	0	06	1	58	3	54	6	01
13	20	22	22	25	0	09	2	02	3	58	6	05
14	20	26	22	29	0	12	2	06	4	03	6	09
15	20	30	22	32	0	16	2	10	4	07	6	13
16	20	34	22	36	0	20	2	14	4	11	6	18
17	20	38	22	40	0	23	2	18	4	15	6	22
18	20	42	22	44	0	27	2	22	4	19	6	26
19	20	46	22	48	0	31	2	26	4	23	6	30
20	20	50	22	52	0	35	2	30	4	27	6	34
21	20	54	22	56	0	38	2	33	4	31	6	38
22	20	58	22	59	0	42	2	37	4	35	6	42
23	21	03	23	03	0	46	2	41	4	39	6	46
24	21	07	23	07	0	49	2	44	4	43	6	51
25	21	11	23	10	0	53	2	48	4	47	6	55
26	21	15	23	14	0	57	2	52	4	51	6	59
27	21	19	23	18	1	00	2	56	4	56	7	03
28	21	23	23	22	1	03	3	00	5	00	7	07
29	21	27			1	07	3	04	5	03	7	11
30	21	31			1	11	3	07	5	07	7	15
31	21	35			1	15			5	11		

and minutes, for every day of the year.

	July		*August*		*Septemb.*		*October.*		*Novemb.*		*Decemb*	
D.	H.	M.	H.	M.	H.	M.	H.	M.	H.	M.	H:	M.
1	7	19	9	22	11	16	13	05	15	05	17	12
2	7	23	9	26	11	20	13	08	15	09	17	17
3	7	27	9	30	11	23	13	12	15	13	17	21
4	7	31	9	33	11	27	13	16	15	17	17	25
5	7	35	9	36	11	30	13	19	15	21	17	30
6	7	40	9	40	11	33	13	23	15	25	17	34
7	7	44	9	44	11	37	13	27	15	29	17	39
8	7	48	9	48	11	41	13	31	15	33	17	43
9	7	52	9	52	11	44	13	34	15	37	17	47
10	7	56	9	56	11	48	13	38	15	42	17	52
11	8	00	9	59	11	52	13	42	15	46	17	56
12	8	04	10	03	11	55	13	45	15	50	18	00
13	8	08	10	07	11	59	13	49	15	54	18	05
14	8	12	10	11	12	03	13	53	15	58	18	10
15	8	16	10	15	12	07	13	57	16	03	18	14
16	8	20	10	18	12	11	14	01	16	07	18	18
17	8	24	10	22	12	14	14	05	16	11	18	23
18	8	28	10	26	12	18	14	09	16	16	18	27
19	8	31	10	29	12	22	14	13	16	20	18	32
20	8	35	10	33	12	25	14	17	16	24	18	36
21	8	39	10	36	12	29	14	20	16	28	18	41
22	8	43	10	40	12	32	14	24	16	33	18	45
23	8	47	10	44	12	36	14	28	16	37	18	50
24	8	52	10	47	12	40	14	32	16	41	18	55
25	8	55	10	51	12	43	14	36	16	46	18	59
26	8	59	10	54	12	47	14	40	16	50	19	03
27	9	03	10	58	12	51	14	44	16	55	19	07
28	9	07	11	02	12	54	14	48	16	59	19	12
29	9	11	11	06	12	58	14	53	17	03	19	16
30	9	15	11	09	13	02	14	57	17	08	19	21
31	9	19	11	13			15	01			19	25

Chap. XXXIII.

By the former Tables of the fixed Stars, and the Suns right aſcenſions, to know the hour of the night, at any time of the year.

BY theſe tables of fixed ſtars, and right aſcenſions of the Sun, you may eaſily know alſo the hour of the night at any time of the year, after this manner: look which of thoſe ſtarres is at the meridian; which may eaſily be known by a Needle-Dial or Compaſſe: or if you will obſerve the North ſtars, that never ſet, (which indeed are fitteſt for this purpoſe, eſpecially when they come to the meridian under the Pole) you ſhall firſt find the place of the Pole in the heavens, ſo neer as you can by eſtimation (for a little errour herein breaks no ſquare) which may be done thus; From the Pole-ſtar directly towards the firſt ſtar next the rump in the great Bears tail, imagine almoſt ſo much ſpace as the Guards are diſtant aſunder, for neer thereabouts is the place of the Pole. Now betwixt your eye and this place of the Pole, hold a plumb-line hanging as perpendicularly, and ſtedfaſtly as you may, and mark withall if that plumb-line come betwixt your ſight, and any of the ſtars noted in the table of fixed ſtars about the Pole; for that ſtar is at the meridian. Then learn (as before was ſhewed) at what time that ſtar cometh to the meridian, and ſo you ſhall have the hour of the night.

Suppoſe for example, the 10 of February you finde after this manner the Swans tail at the meridian, under the Pole, deſiring hereby to know the hour of the night at that time. The right aſcenſion of the Sun for that day you ſhall finde as before to be 22 hours, 14 minutes, whereto you may adde a minute or two more (becauſe that ſtar will come to the meridian very late in the evening) ſo making the Suns right aſcenſion 22 hours, 16 minutes. The right aſcenſion of that ſtar in the ſecond table of fixed ſtars, you ſhall finde to be 20 hours, 30 minutes. From which (becauſe now you deſire to know the time of that ſtars coming to the nether part of the meridian) you may ſubtract 12 hours, and there ſhall remain 8 hours 30 minutes. To this remainer (becauſe it is leſſe then then the Suns right aſcenſion) adde 24 hours, and from the ſumme (32 hours, 30 minutes) ſub-

ſubtract the right aſcenſion of the Sun 22 hours, 16 minutes, ſo there ſhall remain 10 hours, 14 minutes, the time of the night deſired.

CHAP. XXXIV.

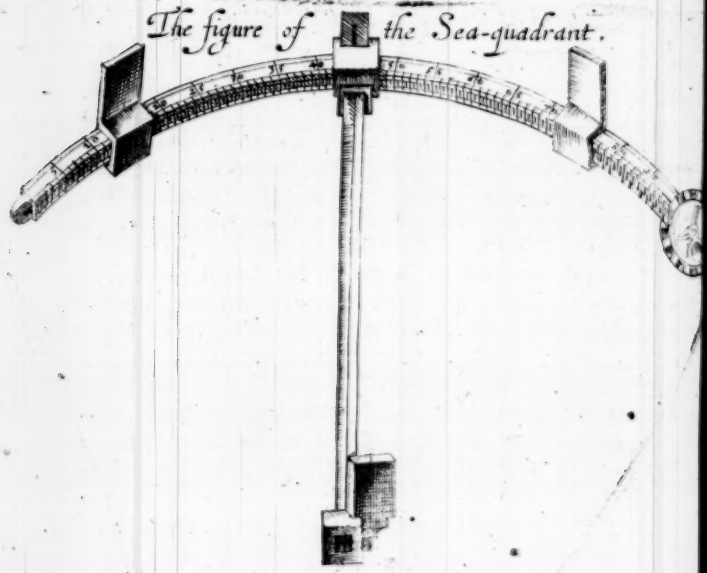
Of finding the elevation of the Pole, by obſervation of the Pole-ſtar and Guard.

BEſides the wayes already ſpoken of to finde the elevation of the Pole by the meridian altitudes, and declinations of the Sunne and fixed ſtars in general: there hath been alſo uſed another way more ſpecial, by the height of the pole-ſtar, when the fore-guard is ſituate from it, either towards the Eaſt, Weſt, North or South, or elſe upon the middle points betwixt theſe principal, as upon the Northeaſt, Northweſt, Southeaſt, and Southweſt points. Of which way, as it hath been hitherto publiſhed and uſed, I muſt for the preſent onely give the Mariner warning that he truſt not to it, being very erroneous, and grounded upon two falſe poſitions. The one is, that the diſtance of the pole-ſtar from the pole is 3 degrees 30 minutes, which by often and exact obſervation is found to be at this time not above 2 degrees, 48 minutes. The other is, that the equations or allowances to be added to, or ſubtracted from the height of the pole-ſtar, to finde thereby the height of the pole, are made the ſame for all latitudes.

But having already ſhewed ſufficiently how to know the latitude almoſt at any time of the night, by the fixed ſtars in the former tables, I hope to be the eaſilier excuſed for finding a fault herein, and not amending it at this time, and that ſo much the rather, becauſe that (according to promiſe made in the firſt Edition of this Book) I will now ſhew the meanes how by obſervation of the pole-ſtar and guards, to finde preſently the height of the pole; not onely when the fore-guard is in ſome one of thoſe eight principal poſitions before-mentioned, as the manner hath been hitherto; but in any other poſition alſo, and at any time of the night, when the pole-ſtar and guards may be ſeen, and that without any allowance or abatement, giving or taking by addition or ſubtraction of any Equation, in regard of the pole-ſtars being higher or lower then the Pole. All which, beſides divers other pleaſant and pro-

fitable conclusions, may easily be performed by means of an Instrument by me divised, which may not unfitly be called the *Sea-Quadrant*, the description and use whereof here followeth.

The figure of the Sea-quadrant.



CHAP. XXXV.

The description and parts of the Sea-Quadrant.

THis Quadrant consisteth of many parts, whereof some may be called principal, and some lesse principal.

The principal parts of this Quadrant are the Semidiameter thereof, and the Arch.

The Semidiameter I call the streight square Ruler.

The arch, I call that part of the Quadrant that is made crooked like a bow.

The lesse principal parts are the double box or locket, and the sights or Vanes.

The

The double box or ſocket hath two ſquare holes made croſſe-wiſe thorow it, in ſuch ſort that the arch and ſemidiameter of the Quadrant may be fitly put thorow them, the flat ſide of the one paſſing cloſe by the flat ſide of the other. By means of this double croſſe ſocket the arch and ſemidiameter of the Quadrant are ſo to be joyned together, that the two angles made by the hollow ſide of the arch, with the ſemidiameter, may be equal each to other.

The ſights or vanes are either fixed or moveable.

There be two fixed ſights; the one greater, the other leſſer.

The greater fixed ſight is faſtened upon the double ſocket, and hath a narrow ſlit cut through the midſt thereof.

The leſſer fixed ſight is faſtened to the end of the arch of the Quadrant, and hath a ſmall ſight-hole bored thorow it, even with the end of the Arch.

The moveable ſights are three in number; whereof two are to be moved up and down upon the arch of the Quadrant, as need ſhall require for obſervation. The third is to be put on, or taken off that end of the ſemidiameter of the Quadrant where the center is, which center is ſhewed by the little round hole bored overthwart thorow the midſt of the thickneſſe of the ſquare Ruler, neer the end thereof; which Ruler we called the Semidiameter of the Quadrant.

This ſight (whenſoever it is to be uſed) muſt ſo be put on upon the end of that Ruler, that the flat ſide thereof (which muſt be ſet towards the arch of the Quadrant) may divide the foreſaid round hole even by the midſt thereof, the ſharp edge of that ſight ariſing perpendicularly from the very midſt or center of that hole; which is alſo the center of the Quadrant, when the other end of the ſquare Ruler, or Semidiameter thereof being put into his ſocket, is thruſt ſo far forwards, that the end thereof cometh to be even with the fore-end of the ſocket.

Two ſides of the arch of the Quadrant, that is to ſay, one of the ſtraight or plain ſides, and the hollow ſide thereof are divided into 90 degrees, and every degree into 6 parts, each part conteining 10 min. and upon the ſtraight ſide of the Quadrant there be figures ſet to every fifth degree, and that in two ranks or limbs; the one beginning from that end of the arch, where the ſmall fixed ſight is placed; the other beginning and proceeding from the other end of the arch, where the Nocturnal is to be faſtened or put on, that ſo the number of the degrees and mi-

nutes might the easilier be reckoned from either end of the arch, as need shall require.

Chap. XXXVI.

Of the Nocturnal or Night-dial.

THe Nocturnal containeth three circles; that is, the hour circle, the day circle, and the pole-star circle.

The biggest of these circles (which is to be fastened to the end of the arch of the Quadrant) I call the Hour-circle, and it is divided into 24 hours, and half hours, with figures set to every hour, for the easier reckoning of them.

Next within this is the Day-circle, or circle of dayes, because it conteineth the dayes of all the moneths of the year; which dayes are signified by the smal divisions round about, at the circumference of this circle. Every fifth day hath his stroke drawn a little longer then the rest, that so any day you desire may the easilier be found. The smal divisions contein but one day apiece, The lines shewing the beginnings and endings of the moneths are drawn overthwart the whole breadth of this circle. The beginning of January is known by the two lines drawn neer together overthwart this circle; whereof one sheweth the end of the moneth of December, and the other sheweth the beginning of the moneth of January, which is marked with two pricks. February is easily known in this circle, because it hath but onely 28 dayes. March is by the little pole-star circle: and so all the rest of the moneths may easily be known by their order. Upon the center of this arch (which representeth the Pole of the World) there be two Indices fastened: the longer of them may be called the Guard-Index, whereto a short pin is fastened underneath, which serveth to set this Index right upon the place of the middle Guard in the day-circle, by putting it into the smal hole that there is made in that circle. The shorter Index reaching from the center of the day-circle, unto the limb or circumference thereof, that is divided into dayes, may be called the Day-Index.

This smal circle placed between the center of the day-circle, and the moneth of March, may not unfitly be called the Pole-star circle; because the distance of the center thereof, from the center of the day-circle, is answerable to the distance of the pole-star from the Pole; which at this time I have often found by exact

exact obſervation, not to be more then 2 degrees, and 48 minutes.

CHAP. XXXVII.

The uſe of the Sea-Quadrant: and that firſt in obſerving the height of the Sun, looking onely by the ſight at the center, to the Horizon at Sea.

TUrn the center of the Quadrant towards the Sun, ſo as the ſhadow of the Vane or ſight placed at the center may fall upon the hollow ſide of the arch of the Quadrant: then looking thorow the little ſight faſtened in the end of the arch of the Quadrant, lay the upper edge of the ſight placed at the center even with the Horizon, and at the ſame inſtant let one that ſtandeth by, mark diligently upon what degree and minute of the Quadrant, the edge of the ſhadow coming from the ſaid edge of the ſight, falleth: for that edge of the ſhadow, upon the hollow ſide of the arch of the Quadrant, ſheweth the height of the upper edge of the Sun. From this therefore ſubtract 16 minutes, and ſo much alſo as is anſwerable to the height of your eye above the water (in ſuch ſort, as I have ſhewed in the uſe of the Croſſe ſtaff, in the 15 Chapter of this Book) and ſo you ſhall have the apparent height of the Sun above the true Horizon.

CHAP. XXXVIII.

How with this Quadrant to obſerve the height of the Sun, with your back turned towards the Sun.

SEt the edge of one of the broad moveable ſights or vanes even with that end of the Quadrant where the little ſight is fixed. Then looking thorow the ſlit which is made thorow the midſt of the middle ſight that is faſtened to the double box or ſocket, turn your back toward the Sun, and laying the edge of the vane at the center even with the Horizon, lift up, or put down the arch of the Quadrant, till the upper edge of the ſhadow of the broad moveable ſight, placed even with the upper end of the arch of the Quadrant, agree juſtly with the edge of the ſight or vane placed at the center. Then reckoning from the upper end of the arch of the Quadrant down-

downwards, see what number of degrees and minutes you finde at the upper edge or end of the socket, through which the Quadrant moveth, adding alwayes thereto two degrees; for so shall you have the height of the Sun (if you abate from hence 16 min. for the Suns semidiameter) and the surplussage answerable to the height of the eye above the water, as before is shewed in the former Chapter.

CHAP. XXXIX.

How to observe with this Quadrant, the height of the Sun, or Star, looking both to the Sun or Star, and to the Horizon.

SEt the upper edge of the uppermost moveable sight of the Quadrant at some even number of degrees, as at 10, 20, or 30. &c. And setting the end of the semidiameter of the Quadrant, where the center is, to the corner of the eye (as you do when you observe with the Crosse-staffe) lay that edge of the sight even with the upper edge of the Sun, and move the nether moveable sight up or down, till the upper edge thereof lie even with the Horizon. Then see how many degrees and minutes are conteined between the upper edges of both sights, from which abate as before 16 minutes for the Suns semidiameter, and the surplus answerable to the height of your eye above the water: so shall you have the apparent height of the Sun above the true Horizon. But when you observe the height of any star, lay the upper edge of the upper sight, even with the midst of the star, and from the number of degrees and minutes conteined between the upper edges of both sights, abate onely the surplus answerable to the height of your eye above the water, and so you shall have the true height of the star. But here it must be remembred, that before you observe the Sun or star after this manner, you must finde out the eccentricity of your eye in such sort as I have shewed in the 15 Chapter of this book: which eccentricity you must adde to the distance of the center of the Quadrant, from the end of the Semidiameter where you set your eye: for so much as the sum of this distance and eccentricity amounteth unto, so much must you thrust forward the foresaid end of the semidiameter of the Quadrant beyond the further end of the square socket thorow which it is put, that so the center of your eye may be brought to the center of the Quadrant.

CHAP.

CHAP. XL.

How to find the height of the Pole, by Observation of the Pole-star and Guard, without giving or taking any allowance or abatement, at any time when the Pole-star, the Guard, and Horizon may be seen.

THE long Index of the Nocturnal (which I called the Guard Index) being fixed upon the place of the middle Guard in the day-circle and the Nocturnal being put upon the end of the arch of the Quadrant, placing also the end of the Semidiamter to your eye, as before, and holding the Quadrant upright, with the Nocturnal towards the Pole-star, till the Diameter of the Semicircular hole of the Pole-star circle lie (by estimation) æquidistant from the Horizon, both ends of the Diameter being level or of like height one with another, and so keeping the Pole-star so neer as you can guesse, upon the midst of that Diameter, and the fiducial line of the Guard-Index upon the Guard, move one of the moveable sights of the Quadrant up or down, till the edge thereof lie even with the Horizon. Thus therefore the Pole-star lying upon the midst of the Diameter, (that is, upon the center of the Pole-star circle) and the fiducial line of the Guard Index upon the Guard, and the edge of the sight even with the Horizon; the number of degrees and minutes from the end of the Quadrant (where the Nocturnal is placed) to the edge of the sight, adding thereto five degrees, that is, the distance of the center of the Nocturnal from the end of the Quadrant, shall be the height of the Pole; saving that you must abate (as before) so much as is answerable to the height of your eye above the water.

To know the Hour of the Night by the Nocturnall.

AND the point of the short Index (which we called the Day-Index) being first set to the day of the moneth, sheweth in the Hour-circle the Hour of the night, at the time of your Observation.

SIMON STEVIN his Errors, *in blaming me of error in my Tables of* Rumbs.

BEfore I end this Treatiſe, I think it meet to ſay ſomething for ſatisfaction of the courteous Reader, concerning ſome faults that *Simon Stevin* of late pretendeth to find in my Table of Rhumbs, publiſhed in the former edition of my Book of *Errors in Navigation*. For not long ſince, there came forth a great Volumne of Mathematical Remembrances; gathered and ſet forth by the ſaid *Stevin*, concerning ſuch points of the Mathematicks wherein that worthy general count *Maurice of Naſſaw* hath for theſe many years ſpent his ſpare hours: whoſe example I wiſh that more of his rank would follow, for the better inabling them to the diſcharge of their duties. In this Volumne *Stevin* going about to ſhew divers wayes for the making of the Table of Rhumbs, cometh in the ſecond place to that way which I have already ſhewed in this book, *chap. 9. pag. 127.* which although he acknowledgeth to be moſt eaſie, and finds no fault with the demonſtrated ground thereof; yet he ſaith my Tables of Rhumbs made according to that way, * have ſome fault in them: but we ſhall (I make no doubt) find a greater fault in his fault-finding. Though I never durſt preſume to imagine I could ſet forth any thing without ſome fault. It ſufficeth me if the fault be ſo little that it cannot ſenſibly be diſcerned; which I hope I ſhall hereafter ſhew. But *Stevin* doth here give us occaſion to expect his Tables of Rumbs, that ſhall have no fault in them, * though now he excuſe himſelf that he had not leiſure to make them. Yet in the mean time he ſhould have done well (in my opinion) to bear with the faults in mine, except they were greater then he hath yet ſhewed any, ſeeing he hath bin content (for want of better to ſerve his turn) to furniſh out thirty Pages of his book in Foho, with my Tables of Rhumbs: beſides ſix other pages which he hath filled with my Table for the true dividing of the Meridians in the Sea Chart, under the name, I confeſſe, not unfitly, of *The Table of Collected Secants*, which in this book I call *A Table of Latitudes, &c.* though he ſomething miſtake the manner of making the

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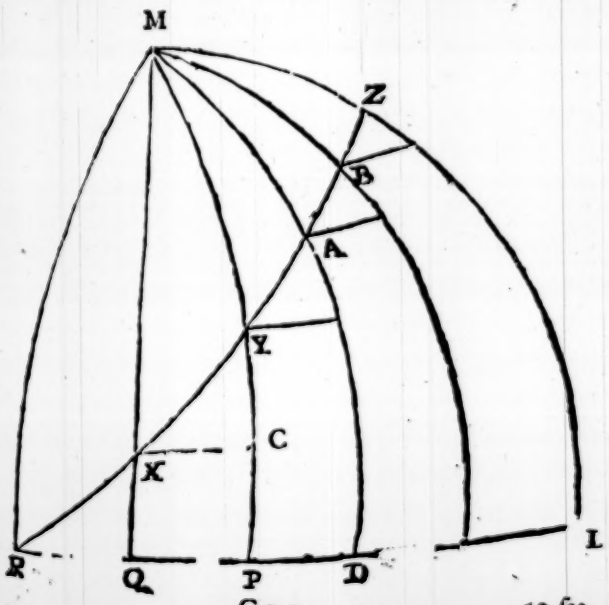
Quodam vitio laborant ſed heus tu, Nulla ne habes vitia? im) haud non fortaſſe minora.

For otherwiſe he ſhould not have blamed mine for having ſome fault in them.

the same; supposing it to be made by continual Addition of the Secants of every tenth minute, whereas indeed I added together the Secants of every single minute (as he might have seen in the Page immediately going before) whereby that Table is more exact then if it had bin made to tens of minutes only. But to return to the fault he findeth in my Table of Rhumbs; *de quo* (he saith) *in λοξοδρομίας Appendice pressius edisseram* in his Appendix or addittament concerning the Rhumbs, he sheweth by what kind of tryal he found so much fault as he speaketh of in that Table, making proof of the fourth Rhumb, which he might easily do by Addition only, without any Multiplycation or Division; because there the whole Sine and Tangent of the Rhumbs angle, (that is 45 degrees) are equal, and this tryal he maketh according to his first way for the making of the Table of Rhumbs, *pag.* 93. and 94. *Lib.* 4. *Geogr.* by the solution of a right angled Sphærical Triangle, wherein (beside the right angle) there is given the angle of the Rumb, with the side adjacent to both those angles. As in the Triangle R Q X having given the angle at Q being a right angle and that at R 45 degrees, with the side R Q 11. degrees he findeth the side Q X 59. minutes,



59. seconds, the Latitude of the fourth Rumb for one degree of Longitude. Then drawing X C Parallel to Q P, so that C P may be equal to Q X, he resolveth in like maner the Triangle Y C X supposing the angle at C and X æqual to those at Q and R and the side X C, æqual to a degree of the Parallel at that Latitude 59. minutes 58. seconds, (but more truly 59. seconds) whereby he findeth the side C Y (in like maner as before) 59 minutes, 57. seconds, (but more truly 58 seconds) which added to P C, 59 minutes 59 seconds, shall make P Y 1 degree, 59 minutes, 56 seconds, as he saith; but more truly it should be 1 degree, 59 minutes, 57 seconds, the Latitude of that Rumb for two degrees of Longitude: and thus he procedeth in all the rest, till he come to 78 degrees of Longitude, (where he saith, he found the Latitude of that Rumb to be 61 degrees, 26 minutes, my Table having no more but 61 degrees 14 minutes, and so the difference of Latitude arising to no more then 12 minutes, for so great a Longitude as 78 degrees. And yet he saith, *Certis rationibus cognorat*, he certainly knew that the true Latitude must needs be lesse then 61 degrees, 26 minutes, which was to him no smal argument, that my Table of Rumbs came very neer the truth, though it hit not the nail on the head (as they say,) Surely therefore Master *Stevin* might have eased me of some trouble, and have saved himself some labour and reputation, both; if he had spared his pains in seeking to find fault with me for so small a matter, whereby Navigators could incur neither dammage nor danger, although mine error were so much as he supposeth. For (in the practise of Navigation) what inconveniencie can arise to the Sea-man by such an error as shall cause him to goe wide of his course no more then 12 minutes, in sailing so far that he must first alter his Longitude 78 degrees, and his Latitude, 61 degrees and more? but the truth is upon due trial, (yea even according to *Stevins* own way) this error will not be found so much as a minute; and to assure my self and others thereof, I took the pains to examine throughout the ground of my Table of Rumbs, that is, the Table of Latitudes, or collected Secants before set down, newly calculating the same twice over for every minute, with the help of two Calculators, alwaies comparing their Calculations together, that when any difference chanced betwixt them, they might still find and amend there fault (if they chanced to make any) before they proceeded any further therein; and by comparing these newly calculated Tables with my former, I could not any where find such difference as could breed any sensible error.

Then

Then something to satisfie Master *Stevins* desire (because he accounteth not his Table of the 8 Rumb taken out of *Appian*, exact enough, shewing only how many minutes and seconds of a degree of the Equinoctial, one degree of each Parallel conteineth for every half degree of Latitude, and that not truly sometimes, as I have tried, I have therefore newly and more exactly calculated such a Table to minutes, seconds, and thirds, and that for every 10 minutes of Latitude, I made also the like Table, to shew how many minutes, seconds, and thirds, of one degree of the Equinoctial, answer to 10 minutes of each Parallel for every 10 minutes of Latitude. By the first of these Tables, I made trial what Latitude the fourth rumb would have at 78 degrees of Longitude, proceeding as *Stevin* did by whole degrees, according to his first way of making the Table of Rumbs, and found the Latitude not much above a minute lesse then his (*viz.*) 61 degrees, 24 minutes, 44 seconds, which difference might partly arise from the imperfection of the foresaid Table of *Appian*, which it seemeth he followed in his calculation. Then by help of the second of these Tables, I made the like triall for every 10 minutes of Longitude, and so found the Latitude of that Rumb at 78 degrees of Longitude to be 61 degrees 15 minutes, 42 seconds, 40 thirds which also must needs be greater then the true Latitude thereof at that place, by the very same reasons whereby *Stevin* saith, he knew certainly that the true Latitude was lesse then 61 degrees 26 minutes: so then the true Latitude of that Rumb for that Longitude, must needs be lesse then 61 degrees, 15 minutes, 43 seconds: therefore by *Stevins* own rule more fitly applyed, my Table of Rumbs accounting that Latitude to be no more then 61 degrees 14 minutes, shall not erre so much as two minutes. Yet indeed more exactly it would rather have been 61 degrees 15 minutes, for to set it down more scrupulously (according to the way I then followed in making that Table) it should be 61 degrees, 14 minutes, 41 seconds. But the truth is, I did not then purpose, nor care to be so curious, thinking it would be sufficient, if my Table of Rumbs erred not any where so much as a minute in the Latitude of any Rumb; which by this triall already made, I assure my self they doe not.

Wherein also I am the more confirmed by the like triall I have made of the first Rumb (counted from the Meridian) though *Simon Stevin* in his solemne demonstration continued almost in three whole pages in folio (wherein he professeth that *the scope or mark he aimeth at, is to demonstrate that my Table* Pag. 153. 154. 155.

of Rumbs is erroneous) would make the world beleeve that my Table erreth above two minutes in the Latitude of that Rumb, before I come to so little as two degrees of Longitude. But the truth is, he much mistaketh the matter, the error being indeed in his own grosse manner of triall, much more then in my Table: for working after his own way by whole degrees, as he doth, it falleth out even so as he saith, that the Latitude of that Rumb for two degrees of Longitude will be above 2 minutes greater then my Table hath. But if he worke the very same way by sixth parts of degrees, or tens of minutes, he shall find but little above half a minute more then is in my Table of Rumbs. Nay moreover, if it shall please him at his leisure to take the pains to make triall hereof to every single minute, he shall not find so much as one second more then my account giveth. For following the very same way that he prescribeth for the true making of the Table of Rumbs in his λοξοδρομίας Appendice pag. 154. 155. and so calculating the Latitude of the first Rumb for every single minute of Longitude, the Latitude of that Rumb for two degrees of Longitude, shall be found to be not so much as 10 degrees 0 minutes 14 sec. 46 third. which Latitude according to my manner of making my Table of Rumbs, is not so little as 10 degr. 0 min. 13 sec. 47 third. differing not so much as one second from the former. But according to M *Stevins* account by whole degrees, it should be 10 degr. 2 min. 6 seconds, exceeding the truth of both the foresaid accounts almost two minutes in Latitude, before he be come to so little as two degrees in Longitude, and so grossely erring himself, whilst he too unadvisedly, and without just cause indevoureth to publish to the world my supposed errors. Which that it may the more manifestly appear, either to him, or to any other that shall be disposed to make triall, as I have done, I have here set down the particular account hereof in the Tables following.

By whole degrees the first Rumbes

Lon-	Latitu.
gr.m.	gr.mi.se.
1 0	5 1 38
2 0	10 2 6

By tens of min. the first Rumbs

Lon-	Latitude.
gr.m.	gr. mi.se.th.
0 10	0 50 16 23
0 20	1 40 32 26
0 30	2 30 47 33
0 40	3 21 1 5
0 50	4 11 12 16
1 0	5 1 20 46
1 10	5 51 25 35
1 20	6 41 26 18
1 30	7 31 22 14
1 40	8 21 12 38
1 50	9 10 57 0
2 0	10 0 34 40

The first table accounting by whole degrees, as *Stevin* doth, sheweth the latit. of the first rumb for 2 gr. of long. to be 10 gr. 2 m. 6 sec. Whereas the second table accounting by tens of minutes, giveth it to be no more then 10 gr. 0 m. 34 s. 40 th. And the third by single min. finds but 10 gr. 0 m. 14 s. 45 thir. 21 fourths.

By

By single minutes, the first Rumbs.					By single minutes, the first Rumbs.				
Longit.	Latitude.				Longit.	Latitude.			
Deg. mi.	gr.	mi.	sec.	th. four.	Degr. mi.	gr.	mi.	sec.	th. four.
0 1	0	5	1	38 25	0 31	2	35	47	48 29
0 2	0	10	3	16 50	0 32	2	40	49	8 18
0 3	0	15	4	55 10	0 33	2	45	50	26 56
0 4	0	20	6	33 25	0 34	2	50	51	44 14
0 5	0	25	8	11 30	0 35	2	55	53	0 17
0 6	0	30	9	49 25	0 36	3	0	54	14 59
0 7	0	35	11	27 10	0 37	3	5	55	28 21
0 8	0	40	13	4 40	0 38	3	10	56	40 17
0 9	0	45	14	41 50	0 39	3	15	57	50 48
0 10	0	50	16	18 40	0 40	3	20	58	59 48
0 11	0	55	17	55 10	0 41	3	26	0	7 18
0 12	1	0	19	31 15	0 42	3	31	1	14 3
0 13	1	5	21	6 55	0 43	3	36	2	18 22
0 14	1	10	22	42 4	0 44	3	41	3	21 6
0 15	1	15	24	16 43	0 45	3	46	4	22 9
0 16	1	20	25	50 47	0 46	3	51	5	21 26
0 17	1	25	27	24 15	0 47	3	56	6	19 3
0 18	1	30	28	57 4	0 48	4	1	7	14 49
0 19	1	35	30	29 12	0 49	4	6	8	8 45
0 20	1	40	32	0 40	0 50	4	11	9	0 50
0 21	1	45	33	31 22	0 51	4	16	9	51 0
0 22	1	50	35	1 14	0 52	4	21	10	39 14
0 23	1	55	36	30 16	0 53	4	26	11	25 27
0 24	2	0	37	58 28	0 54	4	31	12	9 39
0 25	2	5	39	25 53	0 55	4	36	12	51 51
0 26	2	10	40	52 14	0 56	4	41	13	31 57
0 27	2	15	42	17 45	0 57	4	46	14	9 53
0 28	2	20	43	42 5	0 58	4	51	14	45 37
0 29	2	25	45	5 20	0 59	4	56	15	19 11
0 30	2	30	46	27 30	1 0	5	1	15	50 29

By single minutes, the first Rumbs.						By single minutes, the first Rumbs.					
Longitu.		Latitude.				Longitu.		Latitude.			
Degr.	mi.	gr.	mi.	se.	th. four.	gr.	min	gr.	mi.	se	th. four
1	1	5	6	16	19 32	1	31	7	36	9	56 9
1	2	5	11	16	46 14	1	32	7	41	8	55 28
1	3	5	16	17	10 35	1	33	7	46	7	51 20
1	4	5	21	17	32 30	1	34	7	51	6	43 41
1	5	5	26	17	52 0	1	35	7	56	5	32 26
1	6	5	31	18	8 59	1	36	8	1	4	17 34
1	7	5	36	18	23 27	1	37	8	6	2	59 7
1	8	5	41	18	35 19	1	38	8	11	1	36 58
1	9	5	46	18	44 40	1	39	8	16	0	11 8
1	10	5	51	18	51 20	1	40	8	20	58	41 32
1	11	5	56	18	55 20	1	41	8	25	57	8 5
1	12	6	1	18	56 38	1	42	8	30	55	30 51
1	13	6	6	18	55 11	1	43	8	35	53	49 46
1	14	6	11	18	50 58	1	44	8	40	52	4 45
1	15	6	16	18	43 54	1	45	8	45	50	15 48
1	16	6	21	18	33 59	1	46	8	50	48	22 54
1	17	6	26	18	21 13	1	47	8	55	46	25 59
1	18	6	31	18	5 31	1	48	9	0	44	25 3
1	19	6	36	17	46 48	1	49	9	5	42	20 1
1	20	6	41	17	25 4	1	50	9	10	40	10 52
1	21	6	46	17	0 9	1	51	9	15	37	57 36
1	22	6	51	16	31 28	1	52	9	20	35	40 9
1	23	6	56	16	0 31	1	53	9	25	33	18 26
1	24	7	1	15	26 23	1	54	9	30	30	52 27
1	25	7	6	14	49 4	1	55	9	35	28	22 11
1	26	7	11	14	8 34	1	56	9	40	25	47 34
1	27	7	16	13	24 48	1	57	9	45	23	8 40
1	28	7	21	12	37 41	1	58	9	50	20	25 20
1	29	7	26	11	47 13	1	59	9	55	17	37 34
1	30	7	31	10	53 24	2	0	10	0	14	45 21

A Table

Lati.	10 m lon	diffe	Lati.	10 m. lon	diffe.	Lati	10 m. lon	diffe.	Lati.	10 m. lon	diffe.
gr. m.	m. sec th	se. th.	gr. m	mi. se. th.	se. th	gr mi	mi. se. th	sec. th	gr. mi	mi. se. th	se. th.
0 10	10 0 0	0 0	10 10	9 50 35	0 16	20 10	9 23 13	0 36	30 10	8 38 41	0 53
0 20	9 59 59	0 1	10 20	9 50 16	0 19	20 20	9 22 37	0 36	30 20	8 37 52	0 52
0 30	9 59 59	0 0	10 30	9 49 57	0 19	20 30	9 22 0	0 37	30 30	8 36 59	0 53
0 40	9 59 58	0 1	10 40	9 49 37	0 19	20 40	9 21 23	0 37	30 40	8 36 5	0 54
0 50	9 59 56	0 2	10 50	9 49 18	0 20	20 50	9 20 46	0 37	30 50	8 35 12	0 53
1 0	9 59 54	0 2	11 0	9 48 59	0 19	21 0	9 20 9	0 37	31 0	8 34 18	0 54
1 10	9 59 52	0 2	11 10	9 48 39	0 20	21 10	9 19 31	0 38	31 10	8 33 24	0 54
1 20	9 59 50	0 2	11 20	9 48 18	0 21	21 20	9 18 53	0 38	31 20	8 32 30	0 54
1 30	9 59 48	0 2	11 30	9 47 57	0 21	21 30	9 18 15	0 38	31 30	8 31 35	0 55
1 40	9 59 45	0 3	11 40	9 47 36	0 22	21 40	9 17 37	0 38	31 40	8 30 40	0 55
1 50	9 59 41	0 4	11 50	9 47 15	0 21	21 50	9 16 58	0 39	31 50	8 29 45	0 55
2 0	9 59 38	0 3	12 0	9 46 53	0 22	22 0	9 16 19	0 39	32 0	8 28 50	0 55
2 10	9 59 34	0 4	12 10	9 46 31	0 22	22 10	9 15 39	0 40	32 10	8 27 54	0 56
2 20	9 59 30	0 4	12 20	9 46 9	0 22	22 20	9 15 0	0 39	32 20	8 26 58	0 56
2 30	9 59 26	0 4	12 30	9 45 47	0 22	22 30	9 14 20	0 40	32 30	8 26 2	0 56
2 40	9 59 21	0 5	12 40	9 45 24	0 23	22 40	9 13 40	0 40	32 40	8 25 6	0 56
2 50	9 59 16	0 5	12 50	9 45 1	0 23	22 50	9 12 59	0 41	32 50	8 24 9	0 57
3 0	9 59 11	0 5	13 0	9 44 37	0 24	23 0	9 12 18	0 41	33 0	8 23 12	0 57
3 10	9 59 5	0 6	13 10	9 44 14	0 23	23 10	9 11 37	0 41	33 10	8 22 15	0 57
3 20	9 58 59	0 6	13 20	9 43 50	0 24	23 20	9 10 56	0 41	33 20	8 21 18	0 57
3 30	9 58 53	0 6	13 30	9 43 25	0 25	23 30	9 10 14	0 42	33 30	8 20 20	0 58
3 40	9 58 46	0 7	13 40	9 43 1	0 24	23 40	9 9 32	0 42	33 40	8 19 22	0 58
3 50	9 58 40	0 6	13 50	9 42 36	0 25	23 50	9 8 50	0 42	33 50	8 18 24	0 58
4 0	9 58 32	0 8	14 0	9 42 11	0 25	24 0	9 8 8	0 42	34 0	8 17 25	0 59
4 10	9 58 26	0 6	14 10	9 41 45	0 26	24 10	9 7 25	0 43	34 10	8 16 27	0 58
4 20	9 58 17	0 9	14 20	9 41 19	0 26	24 20	9 6 42	0 43	34 20	8 15 28	0 59
4 30	9 58 9	0 8	14 30	9 40 53	0 26	24 30	9 5 59	0 43	34 30	8 14 29	0 59
4 40	9 58 1	0 8	14 40	9 40 27	0 26	24 40	9 5 15	0 44	34 40	8 13 29	1 0
4 50	9 57 52	0 9	14 50	9 40 0	0 27	24 50	9 4 31	0 44	34 50	8 12 29	1 0
5 0	9 57 43	0 9	15 0	9 39 33	0 27	25 0	9 3 47	0 44	35 0	8 11 30	0 59
5 10	9 57 34	0 9	15 10	9 39 6	0 27	25 10	9 3 3	0 44	35 10	8 10 29	1 1
5 20	9 57 24	0 10	15 20	9 38 39	0 27	25 20	9 2 18	0 45	35 20	8 9 29	1 0
5 30	9 57 14	0 10	15 30	9 38 11	0 28	25 30	9 1 33	0 45	35 30	8 8 28	1 1
5 40	9 57 4	0 10	15 40	9 37 43	0 28	25 40	9 0 48	0 45	35 40	8 7 27	1 1
5 50	9 56 54	0 10	15 50	9 37 14	0 29	25 50	9 0 2	0 46	35 50	8 6 26	1 1
6 0	9 56 43	0 11	16 0	9 36 46	0 28	26 0	8 59 17	0 45	36 0	8 5 25	1 1
6 10	9 56 32	0 11	16 10	9 36 16	0 30	26 10	8 58 31	0 46	36 10	8 4 23	1 2
6 20	9 56 20	0 12	16 20	9 35 47	0 29	26 20	8 57 44	0 47	36 20	8 3 21	1 2
6 30	9 56 9	0 11	16 30	9 35 18	0 29	26 30	8 56 58	0 46	36 30	8 2 19	1 3
6 40	9 55 57	0 12	16 40	9 34 48	0 30	26 40	8 56 11	0 47	36 40	8 1 17	1 2
6 50	9 55 44	0 13	16 50	9 34 17	0 31	26 50	8 55 24	0 47	36 50	8 0 14	1 3
7 0	9 55 32	0 12	17 0	9 33 47	0 30	27 0	8 54 36	0 48	37 0	7 59 11	1 3
7 10	9 55 19	0 13	17 10	9 33 16	0 31	27 10	8 53 49	0 47	37 10	7 58 8	1 3
7 20	9 55 6	0 13	17 20	9 32 45	0 31	27 20	8 53 1	0 48	37 20	7 57 4	1 4
7 30	9 54 52	0 14	17 30	9 32 14	0 31	27 30	8 52 12	0 49	37 30	7 56 1	1 3
7 40	9 54 38	0 14	17 40	9 31 42	0 32	27 40	8 51 24	0 48	37 40	7 54 57	1 4
7 50	9 54 24	0 14	17 50	9 31 9	0 33	27 50	8 50 35	0 49	37 50	7 53 53	1 4
8 0	9 54 10	0 14	18 0	9 30 38	0 31	28 0	8 49 46	0 49	38 0	7 52 48	1 5
8 10	9 53 55	0 15	18 10	9 30 4	0 34	28 10	8 48 57	0 49	38 10	7 51 44	1 4
8 20	9 53 40	0 15	18 20	9 29 33	0 31	28 20	8 48 7	0 50	38 20	7 50 39	1 5
8 30	9 53 25	0 15	18 30	9 29 0	0 33	28 30	8 47 17	0 50	38 30	7 49 34	1 5
8 40	9 53 9	0 16	18 40	9 28 26	0 34	28 40	8 46 27	0 50	38 40	7 48 29	1 5
8 50	9 52 53	0 16	18 50	9 27 53	0 33	28 50	8 45 37	0 50	38 50	7 47 23	1 6
9 0	9 52 37	0 16	19 0	9 27 19	0 34	29 0	8 44 46	0 51	39 0	7 46 17	1 6
9 10	9 52 20	0 17	19 10	9 26 45	0 34	29 10	8 43 55	0 51	39 10	7 45 11	1 6
9 20	9 52 3	0 17	19 20	9 26 10	0 35	29 20	8 43 4	0 51	39 20	7 44 5	1 6
9 30	9 51 46	0 17	19 30	9 25 35	0 35	29 30	8 42 13	0 51	39 30	7 42 59	1 6
9 40	9 51 29	0 17	19 40	9 25 0	0 35	29 40	8 41 21	0 52	39 40	7 41 52	1 7
9 50	9 51 11	0 18	19 50	9 24 25	0 35	29 50	8 40 29	0 52	39 50	7 40 46	1 7
0 0	9 50 53	0 18	20 0	9 23 49	0 36	30 0	8 39 37	0 53	40 0	7 39 38	1 7

A Table of the eight Roumb.

Lati.	10 mi. lon		diffe.	Lati.	10 m. lon		diff.	Lat.	10 m lon		diff.	Lat.	10 m. lon		diffe.
gr. mi.	mi	se. th	se. th.	gr. m.	mi. se. th.		se. th.	gr. m.	mi	sec. th	se. th.	gr. m.	mi	se th	se. th
40 10	7 38	30	1 8	50 10	6 24	20	1 20	60 10	4 58	29	1 31	70 10	3 23	14	1 39
40 20	7 37	23	1 7	50 20	6 23	0	1 20	60 20	4 56	58	1 31	70 20	3 21	56	1 38
40 30	7 36	15	1 8	50 30	6 21	39	1 21	60 30	4 55	22	1 31	70 30	3 20	17	1 39
40 40	7 35	7	1 8	50 40	6 20	18	1 21	60 40	4 53	56	1 31	70 40	3 18	38	1 39
40 50	7 33	58	1 9	50 50	6 18	57	1 21	60 50	4 52	25	1 31	70 50	3 16	59	1 39
41 0	7 32	48	1 10	51 0	6 17	36	1 21	61 0	4 50	53	1 32	71 0	3 15	21	1 38
41 10	7 31	41	1 7	51 10	6 16	14	1 22	61 10	4 49	22	1 31	71 10	3 13	41	1 40
41 20	7 30	32	1 9	51 20	6 14	52	1 22	61 20	4 47	50	1 32	71 20	3 12	0	1 38
41 30	7 29	22	1 10	51 30	6 13	31	1 21	61 30	4 46	18	1 32	71 30	3 10	23	1 40
41 40	7 28	13	1 9	51 40	6 12	9	1 22	61 40	4 44	46	1 32	71 40	3 8	44	1 39
41 50	7 27	3	1 10	51 50	6 10	46	1 23	61 50	4 43	13	1 33	71 50	3 7	4	1 40
42 0	7 25	53	1 10	52 0	6 9	24	1 22	62 0	4 41	41	1 32	72 0	3 5	25	1 39
42 10	7 24	43	1 10	52 10	6 8	1	1 23	62 10	4 40	9	1 32	72 10	3 3	45	1 40
42 20	7 23	33	1 10	52 20	6 6	38	1 23	62 20	4 38	36	1 33	72 20	3 2	5	1 40
42 30	7 22	22	1 11	52 30	6 5	15	1 23	62 30	4 37	3	1 33	72 30	3 0	25	1 40
42 40	7 21	11	1 11	52 40	6 3	52	1 23	62 40	4 35	30	1 33	72 40	2 58	46	1 39
42 50	7 20	0	1 11	52 50	6 2	29	1 23	62 50	4 33	57	1 33	72 50	2 57	6	1 40
43 0	7 18	49	1 11	53 0	6 1	5	1 24	63 0	4 32	42	1 33	73 0	2 55	25	1 41
43 10	7 17	37	1 12	53 10	5 59	42	1 23	63 10	4 30	50	1 34	73 10	2 53	45	1 40
43 20	7 16	26	1 11	53 20	5 58	18	1 24	63 20	4 29	17	1 33	73 20	2 52	5	1 40
43 30	7 15	14	1 12	53 30	5 56	54	1 24	63 30	4 27	43	1 34	73 30	2 50	25	1 41
43 40	7 14	1	1 13	53 40	5 55	29	1 25	63 40	4 26	9	1 34	73 40	2 48	44	1 41
43 50	7 12	49	1 12	53 50	5 54	5	1 24	63 50	4 24	36	1 33	73 50	2 47	4	1 40
44 0	7 11	36	1 13	54 0	5 52	40	1 25	64 0	4 23	1	1 35	74 0	2 45	23	1 41
44 10	7 10	23	1 13	54 10	5 51	16	1 24	64 10	4 21	27	1 34	74 10	2 43	42	1 41
44 20	7 9	10	1 13	54 20	5 49	51	1 25	64 20	4 19	53	1 34	74 20	2 42	2	1 40
44 30	7 7	57	1 13	54 30	5 48	25	1 26	64 30	4 18	18	1 35	74 30	2 40	20	1 42
44 40	7 6	44	1 13	54 40	5 47	0	1 25	64 40	4 16	44	1 34	74 40	2 38	40	1 40
44 50	7 5	30	1 14	54 50	5 45	35	1 25	64 50	4 15	9	1 35	74 50	2 36	59	1 41
45 0	7 4	16	1 14	55 0	5 44	9	1 26	65 0	4 13	14	1 35	75 0	2 35	18	1 41
45 10	7 3	2	1 14	55 10	5 42	43	1 26	65 10	4 11	59	1 35	75 10	2 33	36	1 42
45 20	7 1	47	1 15	55 20	5 41	17	1 26	65 20	4 10	24	1 35	75 20	2 31	59	1 41
45 30	7 0	33	1 14	55 30	5 39	51	1 26	65 30	4 8	49	1 35	75 30	2 30	14	1 41
45 40	6 59	18	1 15	55 40	5 38	24	1 27	65 40	4 7	17	1 35	75 40	2 28	32	1 42
45 50	6 58	3	1 15	55 50	5 36	58	1 26	65 50	4 5	38	1 35	75 50	2 26	51	1 41
46 0	6 56	48	1 15	56 0	5 35	31	1 27	66 0	4 4	3	1 35	76 0	2 25	9	1 42
46 10	6 55	32	1 16	56 10	5 34	4	1 27	66 10	4 2	27	1 36	76 10	2 23	28	1 41
46 20	6 54	17	1 15	56 20	5 32	37	1 27	66 20	4 0	51	1 36	76 20	2 21	46	1 42
46 30	6 53	1	1 16	56 30	5 31	10	1 27	66 30	3 59	15	1 36	76 30	2 20	4	1 42
46 40	6 51	45	1 16	56 40	5 29	42	1 28	66 40	3 57	39	1 36	76 40	2 18	22	1 42
46 50	6 50	29	1 16	56 50	5 28	15	1 27	66 50	3 56	3	1 36	76 50	2 16	50	1 42
47 0	6 49	12	1 17	57 0	5 26	47	1 28	67 0	3 54	26	1 37	77 0	2 14	58	1 42
47 10	6 47	55	1 17	57 10	5 25	16	1 28	67 10	3 52	50	1 36	77 10	2 13	16	1 42
47 20	6 46	38	1 17	57 20	5 23	51	1 28	67 20	3 51	53	1 37	77 20	2 11	34	1 42
47 30	6 45	21	1 17	57 30	5 22	23	1 28	67 30	3 49	37	1 36	77 30	2 9	52	1 42
47 40	6 44	4	1 17	57 40	5 20	54	1 29	67 40	3 48	0	1 37	77 40	2 8	10	1 42
47 50	6 42	47	1 17	57 50	5 19	26	1 28	67 50	3 46	23	1 37	77 50	2 6	27	1 43
48 0	6 41	29	1 18	58 0	5 17	57	1 29	68 0	3 44	46	1 37	78 0	2 4	45	1 42
48 10	6 40	11	1 18	58 10	5 16	28	1 29	68 10	3 43	5	1 37	78 10	2 3	2	1 43
48 20	6 38	53	1 18	58 20	5 14	59	1 29	68 20	3 41	32	1 37	78 20	2 1	20	1 42
48 30	6 37	34	1 19	58 30	5 13	30	1 29	68 30	3 39	47	1 38	78 30	1 59	37	1 43
48 40	6 36	16	1 18	58 40	5 12	1	1 29	68 40	3 38	17	1 37	78 40	1 57	55	1 42
48 50	6 34	57	1 19	58 50	5 10	31	1 30	68 50	3 36	39	1 38	78 50	1 56	12	1 43
49 0	6 33	38	1 19	59 0	5 9	1	1 30	69 0	3 35	1	1 37	79 0	1 54	29	1 43
49 10	6 32	19	1 19	59 10	5 7	5	1 29	69 10	3 33	24	1 38	79 10	1 52	46	1 43
49 20	6 31	0	1 19	59 20	5 6	2	1 30	69 20	3 31	45	1 38	79 20	1 51	3	1 43
49 30	6 29	40	1 20	59 30	5 4	31	1 31	69 30	3 30	8	1 38	79 30	1 49	21	1 42
49 40	6 28	20	1 20	59 40	5 3	1	1 30	69 40	3 28	9	1 39	79 40	1 47	38	1 43
49 50	6 27	1	1 19	59 50	5 1	31	1 30	69 50	3 26	51	1 38	79 50	1 45	55	1 43
50 0	6 25	40	1 21	60 0	5 0	0	1 31	70 0	3 25	13	1 38	80 0	1 44	11	1 44

A Table of the eight Rumbs.

A Table of the eight Rumbs.

Lati.	10 m lon	diffe.
gr. mi	m. sc. th.	sec th
80 10	1 42 28	1 43
80 20	1 40 45	1 43
80 30	1 39 0	1 43
80 40	1 37 18	1 44
80 50	1 35 35	1 44
81 0	1 33 52	1 43
81 10	1 32 8	1 44
81 20	1 30 25	1 43
81 30	1 28 41	1 44
81 40	1 26 58	1 43
81 50	1 25 14	1 44
82 0	1 23 40	1 44
82 10	1 21 57	1 43
82 20	1 20 3	1 44
82 30	1 18 19	1 44
82 40	1 16 35	1 44
82 50	1 14 51	1 44
83 0	1 13 7	1 44
83 10	1 11 23	1 44
83 20	1 9 39	1 44
83 30	1 7 55	1 44
83 40	1 6 11	1 44
83 50	1 4 27	1 44
84 0	1 2 43	1 44
84 10	1 0 59	1 44
84 20	0 59 15	1 44
84 30	0 57 31	1 44
84 40	0 55 46	1 44
84 50	0 54 2	1 44
85 0	0 52 18	1 44
85 10	0 50 33	1 45
85 20	0 48 49	1 44
85 30	0 47 5	1 45
85 40	0 45 20	1 45
85 50	0 43 36	1 44
86 0	0 41 51	1 45
86 10	0 40 7	1 44
86 20	0 38 22	1 45
86 30	0 36 38	1 44
86 40	0 34 53	1 45
86 50	0 33 9	1 44
87 0	0 31 24	1 45
87 10	0 29 40	1 44
87 20	0 27 55	1 45
87 30	0 26 10	1 45
87 40	0 24 26	1 44
87 50	0 22 41	1 45
88 0	0 20 56	1 45
88 10	0 19 12	1 44
88 20	0 17 27	1 45
88 30	0 15 42	1 45
88 40	0 13 58	1 44
88 50	0 12 13	1 45
89 0	0 10 28	1 45
89 10	0 9 44	1 44
89 20	0 6 59	1 45
89 30	0 5 14	1 45
89 40	0 3 29	1 45
89 50	0 1 45	1 44
90 0	0 0 0	

A Table of the Eight Rumb.

This Table of the eight Rumb, shewing the quantity of 10 minutes of Longitude at every 10 minutes of Latitude, in minutes seconds, and thirds of one degree of the Equinoctial, I thought good here to adjoyn for their sakes that may peradventure be desirous by themselves to make triall of that I have before written, concerning the grosse and rude manner of examination, which *Simon Stevin* useth, to make the world beleeve that my Table of Rumbs is so much erroneous as he saith, and after his fashion would seeme to demonstrate. And lest any should suspect that this Table also may be as faulty as *Stevin* would perswade us the other is, I have thought good here to shew the way how I made the same, that if any list take so much pains, he may either examine and correct this if need shall be, or make a new one if he will, which may be done after this manner, and by this rule: What proportion the whole sine hath to the sine of the Latitudes complement; the same proportion hath one sixth part of a degree of the Equinoctial, that is, 10 minutes, which make 36000 thirds, to the number of the same thirds of a degree of the Equinoctial, contained in 10 minutes of Longitude at the same Latitude, which being divided by 60, the remainder shall be the thirds remaining besides minutes and seconds, and this first quotient being again divided by 60, the second quotient shall be the minutes, and the remainder thereof the seconds. For example, suppose you would find the quantity of 10 minutes of a degree in the Parallel, whose Latitude is 10 degrees; now the complement of this Latitude is 80 degrees, the sine whereof is 9848,078, the whole sine being 10,000,000: and as this whole sine is to the sine aforesaid, so is 36,000 (that is, the number of thirds that are in ten minutes of the Equinoctial) to 35,453, that is, the number of the same thirds contained in ten min. of a degree of the said Parallel. And these thirds divided by 60, give

in the quotient 590 sec. and 53 thirds remaining, and 590 divided again by 90, the quotient is 9 m. and the remainder 50 sec So then, the quantity of ten min. of Longitude at ten degr. of Latitude, shall be 9 min. 50 sec. 53 thirds of one degree of the Equinoctial. And thus was made the whole Table.

The making of the Table of Rumbs.

Now by help of this Table of the eight Rumb, the preceding Table of the fifth Rumb next the Meridian, and all the rest may thus be made: As the whole sine, is to the Tangent of the Rumbs angle with the Equinoctial; so is one minute of the Equinoctial to the Latitude of the same Rumb for one minute of Longitude. And so is a minute of Longitude (found out by this Table of the eighth Rumb) at that Latitude, to the difference of Latitude; which added to the former Latitude, giveth the Latitude of the same Rumb, for two minutes of Longitude: and again at this Latitude, a minute of Longitude (found by the same Table) shall have the same proportion to the difference of Latitude; which added to the Latitude of the same Rumb for two minutes of Longitude, sheweth the Latitude of that Rumb for three minutes of Longitude. And after this manner proceeding in all the rest, you may make up the whole Table of Rumbs.

FINIS.

THE DIVISION OF THE WHOLE ART OF NAVIGATION.

THE whole Art of *Navigation*, which teacheth us to ſail by courſes and by heights, is divided into two principal parts; the Theorick, and the Practick. The Theorick teacheth the compoſition of the Sphere of the World in general; and in particular informeth us of the number, figure, and motions of the Heavens, eſpecially of the higheſt moveable heaven, called *Primum Mobile*, and of the ninth, eighth, fourth, and firſt heaven: alſo it ſheweth us the quantity and ſituation of the elements, and principally of the earth and water; and the circles which are imagined to be in that Sphere; without the knowledge of which it is impoſſible to be a Navigator. The Practick part teacheth the making and uſe of thoſe Inſtruments which are uſed in Navigation, as namely the Aſtrolabe, the Croſſe-ſtaffe, the Sea-compaſſe, and the Dial, with the Regiment of the Sun, and of the ſtar, the rules of the Moon, and of the Tides, the declaration of the Sea-chart, and other things appertaining hereunto.

CHAP. I.

The Definition of the Sphere.

A Sphere is a ſolid or maſſie body, without hollowneſſe, and perfectly round; in the midſt whereof there is a prick called the center, by which there paſſeth a right line, named the Axtree, and the points where this line endeth upon the ſuperficies of the whole body are called Poles, becauſe upon them the Sphere is moved.

CHAP. II.

That the whole World is a Sphere.

AND ſo it is evident that the whole frame of the World wherein we live is a Sphere; being as it is ſolid, ſo that in the whole World there is no empty place: alſo it is perfectly round upon the upper Superficies of the higheſt heaven: and it hath in the very midſt a certain point, to wit, the center of the earth, by which we do imagine a right line or Axtree, to paſſe from one pole to another, upon which the World is moved about from Eaſt to Weſt.

CHAP. III.

Of the diviſion of the Sphere.

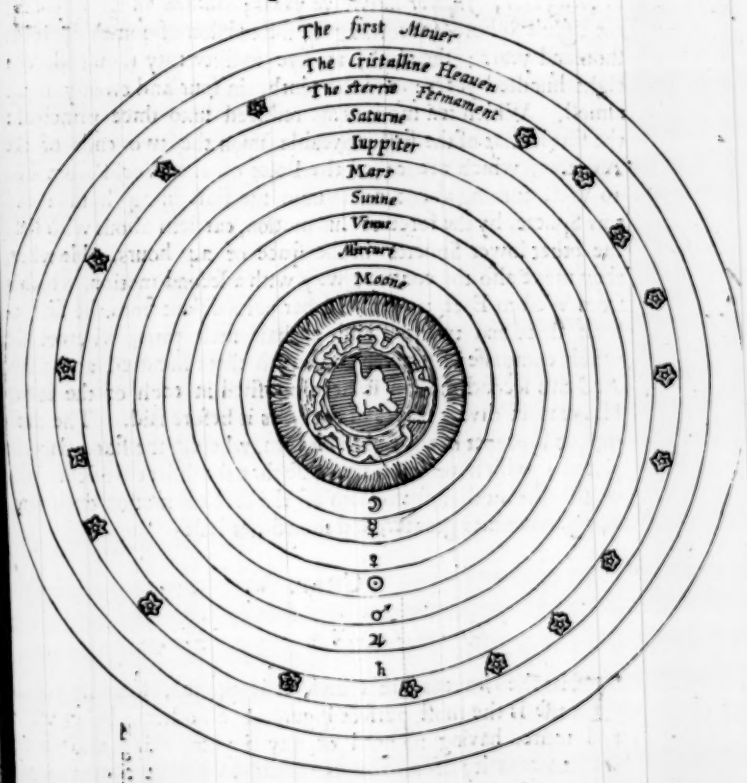
THE whole Sphere of the World is divided into two parts or Regions; the Elementary and Celeſtial. The Elementary part or Region hath four parts: the firſt whereof is the earth, which together with the element of water (which is the ſecond) maketh one perfect Globe: and round about both theſe are two other elements, namely, the Air, and above that the fire, which filleth the ſpace between the Air, and the Sphere of the Moon: of which Elements (by vertue of the heat of the Heavens) are made and compounded all corruptible things in the world.

The celeſtial Region conſiſteth of other ten parts: the firſt whereof is the Sphere of the Moon; the ſecond the Sphere of *Mercury*; the third, of *Venus*; the fourth, is the Sphere of the

Sun;

Sun; the fifth, of *Mars*; the sixth, of *Jupiter*; the seventh, of *Saturn*; the eighth, is the Sphere of the fixed ſtars, which is called the Firmament; the ninth, is the Cryſtalline heaven; and laſtly, the tenth and higheſt, is the Sphere, called the *Primum mobile*, that is, the firſt or higheſt moveable heaven. That which remaineth, called the Empyreal heaven, becauſe it hath no motion, cometh not to be conſidered on in the Art of Navigation.

A Figure wherein may be ſeen the Compoſition of the whole Sphere *of the World.*



Chap. IV.

Of the motion of the Heavens.

THe number of the Heavens is known by the motions obſerved in them, which are ten, diſtinct one from another. For the Moon moveth her proper and peculiar motion in 27 dayes, and 8 hours, which is one Revolution: *Mercury*, *Venus*, and the *Sun* finiſh their motion in one year, which conteineth 365 dayes, and almoſt a quarter of a day: *Mars* runneth his courſe in two years; *Jupiter* in twelve years; *Saturn* in thirty years; the eighth Sphere (according to the opinion of ſome) in ſeven thouſand years; the ninth, in five and twenty thouſand, and eight hundred years: and the tenth, in four and twenty hours almoſt. Which ten motions are reduced unto three principal: the firſt is that of the firſt moveable upon the two ends of the Axletree, which are called the Poles of the World from Eaſt to Weſt, turning about again unto the Eaſt in 24 hours: and this Sphere, by the force of his motion, carrieth about with it all the other lower Spheres in the ſpace of 24 hours. Howbeit, they move alſo the contrary way with a ſecond motion, which is from Weſt to Eaſt, upon two other poles diſtant from the firſt, about three and twenty, and an half ſuch parts, whereof the whole compaſſe of heaven conteineth three hundred and ſixty. And this ſecond motion is accompliſhed in each of the lower Heavens, in divers ſpaces of time, as is before ſaid. The third motion is proper to the eighth Heaven, wherein the fixed ſtars are placed; which motion is the cauſe that the diſtance of the poles of the firſt motion, from them of the ſecond motion doth vary, being ſometimes greater, and ſometimes leſſe.

Chap. V.

Of the Figure of the Heavens.

THat the Heavens are round, it is proved, becauſe roundneſſe is the moſt perfect Figure of all others, being whole and intire, having no need of any joynts, being alſo of the greateſt capacity of all figures that have the ſame compaſſe, and in that reſpect moſt fit to contain all other things. Alſo the principal bodies of the World, as the Sun, the Moon, and the ſtars

are of this Figure, and we ſee the ſame likewiſe in thoſe things which are bounded by themſelves; as it is manifeſt in drops of water, and all other liquid things.

CHAP. VI.

That the Earth and Water make one perfect Globe.

THere is nothing that ſheweth more cleerly that the earth and water make one round Globe, then the ſhadow which they make in the Eclipſes of the Moon; which ſhadow we alwayes ſee to be a part of a circle. For if the body, which is the cauſe of the ſame ſhadow, were three-ſquare, or four-ſquare, the ſhadow it ſelf alſo would appear in the ſame faſhion. Wherefore the ſhadow of theſe two bodies together, being round, it is manifeſt that they are round alſo.

CHAP. VII.

That the Earth is in the center of the World.

ONe ſign we have to be aſſured, that the Earth is in the midſt and center of the World; namely, that whereſoever we are upon the face of the earth, we alwayes ſee one half of the Heavens, the other half being hidden out of our ſight. Moreover, the ſtars (in what part of the Heavens ſoever they be) either in the Eaſt, Weſt, or South, we ſee that they are alwayes of the very ſame bigneſſe. Whereby we may eaſily perceive, that they are alwayes equally diſtant from our ſight: and whereas they move round about it, it followeth, that we are upon the center of that body, on whoſe ſuperficies the ſaid ſtars deſcribe their circles.

CHAP. VIII.

The whole quantity of the Earth.

AND albeit the Globe of the Earth and Water, compared with the Spheres of the Stars, is as it were a center or prick; yet being conſidered by it ſelf, it conteineth in the greateſt circle thereof 6300 common Spaniſh leagues. Which a man may eaſily perceive, by taking two ſuch points or head-lands

of the earth, as are under the ſame Meridian, and which differ in diſtance one from another ſo much as one of thoſe parts is, whereof the compaſſe of the whole world conteineth 360; and it is found both by Navigation at Sea and alſo by travel on land, that the two foreſaid points are diſtant each from other 17 leagues and an half: of which leagues, each one conteineth 4000 paces, every pace 5 foot, every foot 16 fingers, and every finger 4 grains of barley.

Chap. IX.

Of the Equinoctial Circle.

BEing to treat of the Circles of the Sphere of the World, the firſt which offereth it ſelf to be ſpoken of, is the Equinoctial Circle; by means whereof we do know in what part of the World we are: and in it, in the Sea-Chart are placed all theſe points or degrees of Longitude, and from it the Latitudes are accounted. So that the Equinoctial is a Circle which divideth the World into two equal portions, and is equally diſtant every where from either of the poles. And it is called the Equinoctial Circle; becauſe that when the Sun paſſeth under it, upon the 11 of *March*, and the 13 of *September*, it maketh the day equal to the night. The knowledge of this Circle in the Art of Navigation, doth help us to find the Latitude or diſtance from the Line; and from this Circle are reckoned the declinations of the Sun in the regiment thereof. And alwayes thoſe Charts of Navigation which are either univerſal, or half univerſal, have this Equinoctial circle, drawn with a great red line, which paſſeth by the beginning of the account of the degrees of Latitude.

Chap. X.

Of the Poles of the World.

AND here it is to be noted, that one of thoſe two Poles, (from which the Equinoctial is equally diſtant) which is alwayes in our ſight, (becauſe it is continually above our Horizon) is called the Pole-artick, the Septentrional, or North Pole. But the other oppoſite pole (which we never ſee, becauſe it is under our Horizon) is called the Pole-antartick, and the Meridional, or South Pole. And ſo that part of the world which is between

the

the Equinoctial and the North pole, is called the North part, and that which is from the Equinoctial to the South pole, is called the South part.

CHAP. XI.

Of the Ecliptick line

THe Equinoctial circle is divided into equal parts by another circle called the Ecliptick, whereof one half is between the Equinoctial and the North pole, and the other half between the Equinoctial and the South pole. And that part thereof which is furtheſt diſtant from the Equinoctial, is diſtant from the ſame about 23 degrees and an half. And becauſe the Sun moveth in this circle without departing from it, hereof proceed the Declinations thereof. And this circle in all parts is equally diſtant from the Poles of the ſecond motion, which are called the Poles of the Ecliptick. And through this circle the Sun is continually moved by his propper motion from Eaſt to Weſt: by means of which motion ſometimes he paſſeth under the Equinoctial, and at other times departeth from it, both towards the North and towards the South: and the quantitie of his greateſt diſtance is about 23 degrees and an half: and ſo much is the diſtance of the Poles of the Ecliptick, from the Poles of the Equinoctial. And albeit this circle is not drawn in the Sea Chart, yet is it in ſome ſort repreſented in the Table of the Suns Declination, which are gathered from the motion which the Sun maketh under the Ecliptick.

CHAP. XII.

Of the Declination of the Sun.

THe motion of the Sun under the Ecliptick, is the cauſe of his Declination: which is nothing elſe but the daily ſwarving or Declining of the Sun from the Equinoctial line. And this Declination when the Sun is under the Equinoctial, upon the eleventh of *March*, and thirteenth of *September*, is nothing at all: ſo likewiſe upon the twelfth of *June*, and twelfth of *December*, the Declination is at the greateſt. And albeit this greateſt Declination be now in our time about three and twenty degrees and an half; yet hath it at other times

times been found otherwise, by reason of a third motion proper to the eighth Heaven: but it alwaies keepeth between 23 degrees, 28 minutes; and 23 degrees, 53 minutes. From hence therefore we doe infer, that at divers times it is meet to make new and divers Tables of the Declination of the Sun.

Chap. XIII.

Of the Colures.

There are two Circles of the Sphere, either of which divideth it into two equal parts: and they are called Colures, because that in the revolution which they make, by force of the *Primum mobile*, they doe not shew themselves wholly unto us; so as we may see all parts of them. One of them is called the Equinoctial Colure, because it passeth by the Poles of the World, and the points where the Ecliptick cutteth the Equinoctial; and when the Sun by his own proper motion commeth unto it, he maketh the day and the night equal, and divideth the Winter from the Spring by the one part; and by the other, Summer from Autumne; at which times the Sun hath no declination at all. The other is called the Solstitial Colure, because it passeth by the Poles of the World and of the Ecliptick, and by the points where the Ecliptick is furthest distant from the Equinoctial. And when the Sun by his proper motion commeth unto it, in the one part it maketh the longest day, and the shortest night, and divideth the Spring from the Summer, and hath his greatest Declination towards the North: and being in the other part, the Sun maketh the longest night, and shortest day, and divideth Winter from Autumne, and is in his greatest Southerly Declination. These two Colures are noted in the Table of the Suns Declination because the Equinoctial Colure passeth by the two points, where there is no Declination at all; because the Sun is under the very Equinoctial circle: and the Solstitial Colure passeth by that place where the Sun hath his greatest Declination, which is in 23 degrees and an half, or thereabouts.

Chap. XIV.

Of the Meridian circle.

The Meridian is a circle drawn by the Poles of the World (which are all one with the Poles of the Equinoctial) and by

and by the point directly over our heads called the *Zenith*. And it is called the Meridian, because that when the Sun by the motion of the *Primum mobile* commeth unto this circle, it maketh mid-day, and then he hath been running his course from his rising till he come thither, just so long time as he shall be running from thence to the place of his setting. The *Zenith* is a point in the Firmament, placed directly over our heads. And it is to be noted, that when the Sun is in that Circle, it hath the greatest altitude above our Horizon, that it can possibly have the same day: by this and the Declination, we come to know how far we are distant from the Equinoctial, either towards the North, or towards the South. And hence it is, that the height of the Sun in Navigation is understood onely for that height which the Sun hath, when he is in this Circle. And so the height of the Sun shall be that part of the Meridian, which is contained between the Sun and our Horizon. This Circle in the Sea-Chart is represented by all those lines which are drawn from North to South.

CHAP. XV.

Of the Horizon.

THe Horizon is a Circle which divideth that part of the Heavens which we see from the residue which we do not see: and it is properly that Circle by which, according to our sight, the Heaven seemeth to be joyned with the water, when we are at Sea, without sight of any land. This Horizon is of two sorts, namely, right and oblique. The right Horizon is that which they have that live under the Equinoctial, which passeth by their Zenith; and therefore the Equinoctial line or circle falleth perpendicularly and right across with their Horizon, and both the South and the North Poles are in their Horizon. The oblique Horizon is that which they have that live not directly under the Equinoctial; for unto them the Equinoctial divideth the Horizon obliquely, and not right across: and one Pole is alwayes above their Horizon, and the other is beneath their Horizon, and cannot be seen. This Horizon is represented in the Sea-Chart by a certain imagined circle, whose center is the point where our ship is From which center are imagined to proceed unto the said circle 32 lines, which represent the 32 winds or rumbs; which alwayes are drawn in our Sea-Compasse: which

likewiſe in a little peece of paper doth continually repreſent unto us both by day and night, the whole Horizon, with his 32 diviſions.

CHAP. XVI.

Of the 32 Winds.

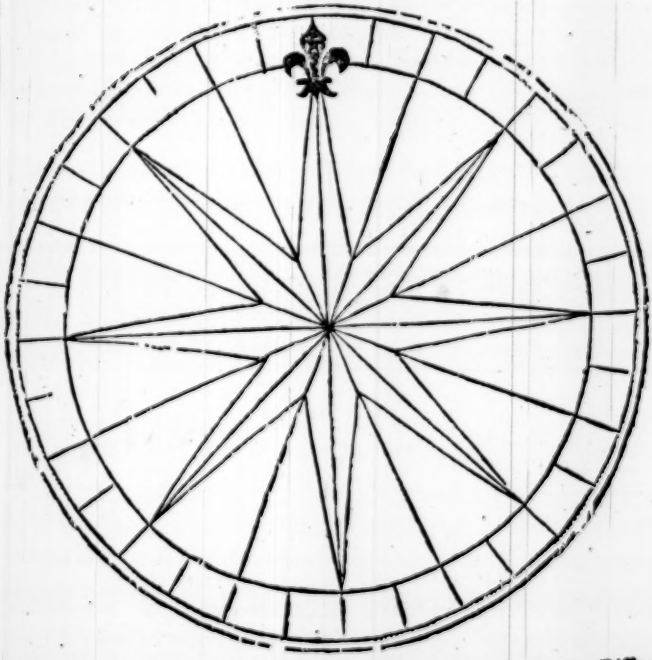
THis right or oblique Horizon is divided into 32 equal parts by 16 lines, which they call Rumbs: and they cut themſelves in the point where we ſtand: of which rumbs, that which paſſeth by the points where the Equinoctial beginneth and endeth (which are where the Sun riſeth and ſetteth the 11 of *March*, and the 13 of *September*) is called Eaſt and Weſt; and that which cutteth it right acroſſe, is named North and South. And the four extreams or ends of theſe two lines, are diſtant upon the Horizon one fourth part of a circle, and they make four quarters. Every one of which quarters being divided in the midſt, do make four other points: and that which falleth between the North and the Eaſt, is called North-eaſt; and that between the North and the Weſt, North-weſt; that between the South and the Eaſt, South-eaſt; and that between the South and the Weſt, South-weſt. And ſo the Horizon is divided by four lines or rumbs, into eight principal winds, noted in the *Sea*-Chart with black lines. And if you divide every one of thoſe eight parts in the midſt, you ſhall have other eight lines, and other four rumbs, which in all are 16 winds. And each one of theſe hath his name compounded of the names of thoſe principal winds, which are on either ſide thereof. As for example, that half winde which is between the North, and the North-eaſt. is called North-north-eaſt, and that which bloweth between the Eaſt and the North-eaſt, is called Eaſt-north-eaſt; and that between the Eaſt and the *South*-eaſt, Eaſt-ſouth-eaſt; and that between the *South* and the *South*-eaſt, *South*-ſouth-eaſt; and that between the *South*-weſt and the VVeſt VVeſt-ſouth-weſt; and that between the VVeſt and North-weſt, Weſt-north-weſt; and that between the North-weſt and the North, North-north-weſt. And theſe are noted in the Chart with green lines.

Finally, if you divide every one of theſe ſixteen winds in the midſt, they will yield you other 16 winds, and will amount to 32 winds in all. Which 16 laſt mentioned, are drawn in the *Sea*-Chart with red lines, and are by the Spaniards called quarters of

the

the eighth first and principal winds: and every one of these is called by the name of that principal wind which is next it, together with an addition of the word (By) and the name of another principal wind which is next unto it. As for example, of the two quarter-winds which fall next the rumb of the North, that which lieth towards the North-east is called North and by East; and that which falleth towards the North-west, is called North by West. So likewise of those two winds, which blow next the North-east, that towards the North is called North-east and by North: and that towards the East, North-east and by East. And after the same manner you may name all the rest.

The Figure of the Sea-Compasse, and of the Horizon, divided into 32 Winds, by 16 Rumbs.



But here is to be noted, that there is difference between the Rumb and the Wind, because a Rumb is one direct line continued with two contrary winds, as the Rumb of North & South, and

Difference between the Rumb and the Wind.

and the Rumb of East and West. And so when we will name the lying of any Coast, we will say, that it lieth North and South, or North and by East, and South and by West. But the wind is one line of those 32, into which the Horizon is divided; and it is one part of those two which together are called the Rumb. And so we say, that Land lieth from us towards the South, or towards the South and by West, or towards the South-south-west, &c.

Chap. XVII.

Of the two Tropicks.

Besides the six Circles above-mentioned, which are drawn upon the superficies of the Sphere of the World; there are other two which the Sun describeth with the motion of the *Primum Mobile*, about the 12 day of *June* and of *December*; of which two Circles that which the Sun describeth the 12 of *June*, from the time of his rising, till the time that he riseth the day following, is called the Tropick of the Summer Sun-standing; or the Tropick of *Cancer*: for the Sun having departed from the Equinoctial, and increasing his Declination towards the North, when he cometh to describe that Circle, for two or three dayes it seemeth, that he cometh no neerer to our Zenith, nor departeth from the Equinoctial one day more then another: but from thence forward he goeth back, diminishing his Declination, till he come to the Equinoctial; and crossing the same, he goeth on the other side, increasing his Declination until the 12 of *December*, upon which day, from the time of his rising, till he be come about to rise again the next morning, he describeth another Circle, called the Tropick of the Winter Sun-standing, or the Tropick of *Capricorn*; for the Sun being departed from the Equinoctial, and increasing his Declination towards the South, when he cometh to describe that Circle, it seemeth for two or three dayes, that he returneth not one whit towards the Equinoctial, nor goeth further from our Zenith one day more then other; but from thence forwards he commeth back again, diminishing his Declination, till he be returned to the Equinoctial, and from thence towards our Zenith. These two Circles in Sea-Charts are marked with two great red lines drawn from East to West, which lie on either side of the Equinoctial, being distant from thence about 23 deg. and an half. And wheresoever our

ship

ſhip be in any place between theſe two Circles or lines, we may in ſome time of the year take the Sun in our Zenith, at which time it maketh no ſhadow at all, being then juſt 90 degr. high above our Horizon. But they which are without the ſaid two Circles or lines, ſhall never have the Sun in their Zenith, becauſe it cannot come to the height of 90 degr. above their Horizon.

CHAP. XVIII.

Of the Parallels

THe parallel Circles are thoſe which are in all parts equally diſtant from the Equinoctial. And theſe Circles may be infinite between the Equinoctial, and the North and South Poles; and in the Sea-chart ſome of them are repreſented by the lines which are drawn from Eaſt to Weſt. And two of theſe Circles are the two Tropicks of *Cancer* and *Capricorn*, which are the bounds of the Suns greateſt Declinations. Likewiſe all thoſe Circles which the Sun and the ſtars in Heaven do by the motion of the firſt or higheſt moveable heaven deſcribe from Eaſt to Weſt, are parallels, and ſerve in the Sphere to ſhew the Latitude. And when a ſhip ſaileth in the ſame height of the pole, then ſhe ſaileth in a parallel and runneth alwayes Eaſt or Weſt. Which manner of ſailing we uſe at all ſuch times, when we find our ſhip in the height of that land, to which we are going.

CHAP. XIX.

Of the Degrees.

EVery one of theſe Circles is divided into 360 equal parts, which they call degrees, and every degree is divided into other 60 equal parts, which are called minutes: which degrees and minutes, are the common meaſure that we uſe in Navigation, when we make any account in the Heavens, either in taking the height of the Sun and ſtars above the Horizon, or in meaſuring the diſtance from our Zenith to the Equinoctial. Theſe degrees are marked in a line drawn from North to South in the moſt vacant part of the Sea-Chart. This line in general Sea-Charts is divided into 90 equal parts, which are counted (beginning at the Equinoctial line) from one to 90, both Northwards and Southwards. And in thoſe Charts which are not general, this line hath

ſuch diviſions as it is capable of, according to the largeneſſe of the Chart, beginning to make account from the Equinoctial.

Chap. XX.

What is meant by Longitude and Latitude.

THe Longitude of any place is a part of the Equinoctial, or of ſome other parallel contained between two Meridians, whereof one paſſeth by the Canary Iſlands, and the other by the place given; but if neither of the ſaid Meridians paſſe by the foreſaid Iſlands, it is called reſpective Longitude. And this reſpective Longitude is called in the Art of Navigation the diſtance or length of the right line; which is determined or bounded by two other right lines running North and South; of which two, the one paſſeth by the Port or Haven from whence we ſet ſail, and the other by the place where our ſhip is. And ſo ſhall the diſtance of the right line be the part of any right line whatſoever running Eaſt and Weſt, comprehended between the two foreſaid right lines extended North and South.

The Latitude of a place is a part of any Meridian whatſoever contained between two parallels, whereof one is the Equinoctial, and the other the parallel of the place given. This Latitude the Mariners do call the Diſtance from the Line; underſtanding by the Line, the moſt principal of all others, which are drawn in the Chart, that is, the Equinoctial Line. They uſe alſo to call it the heighth, which is as much to ſay, as the heighth of the Pole above the Horizon. And ſo the Diſtance from the Equinoctial ſhall be a part of any North and South Line contained between the Equinoctial and any line running from Eaſt to Weſt, which paſſeth in the graduation of the Chart, by the ſame degree of Latitude in which we find our ſelves to be.

The Equinoctial is called the line, becauſe it is the principal of all others which are drawn in the Chart.

The

THE SECOND PART OF THE Art of Navigation.

Wherein is handled the Practick Part, ſhewing the making and uſe of the principal *Inſtruments* belonging to this ART.

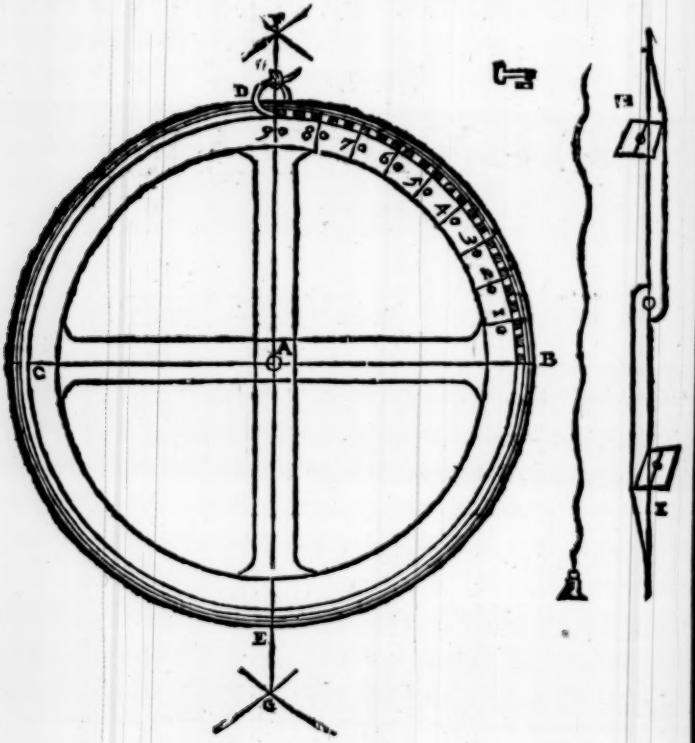
CHAP. I.

The making of the Aſtrolabe.

TO know the Latitude or diſtance from the Equinoctial line there are required five things; whereof any one being wanting, we cannot poſſibly finde out how far we are diſtant from the ſaid Line. And theſe are, the Aſtrolabe or Quadrant, the height of the Sun, the Shadows, the Declination, the Regiment or Rules of the Sun.

The Aſtrolabe is to be made after this manner: In the midſt of a round plate or table of mettal or wood, being ſmooth and plain every where, and about a finger thick, you ſhall take the center A, wherein having placed one foot of your compaſſes, you ſhall with the other draw as great a circle as conveniently you can in the ſaid Table. And within this Circle muſt be drawn two other Circles, the one diſtant from the other about the breadth of a grain of wheat, and the third muſt be diſtant from the ſecond twice ſo much as the ſecond is from the firſt.

And



And your Ruler being laid just to the center **A**, you shall draw the line B A C, which divideth every one of the three circles into two equal parts. And putting one point of your compasses (standing open according to the length of the line B C) upon the point C, where the greatest Circle is divided by the line B C; with the other point, you shall draw above the point D a part of a Circle, and another under E. And then putting one foot of the compasses thus opened upon the point B, you shall draw other two parts of a Circle, which will crosse the first in F and G. And your Ruler being laid to F and G, you shall draw the line D E, which must passe by the center A. Then let the Quadrant D B be divided into 3 equal parts, and every one of those

those into three other parts, and each of those nine into two, and every one of those 18 into 5; and so the said Quadrant shall be divided into 90 equal parts or degrees. Unto which degrees shall be placed the numbers belonging to them from 5 to 5, between the second and the third circle, beginning from B and ending with 90 at the point D. Then let there be made at the point D a little hole upon the line D E, through which may be put a little ring, or some strong riband or string, and you shall make a knot thereon, whereby your finger may take hold: and the Astrolabe hanging by that hole, you shall put through a slender threed with a plummet of lead, which may hang quite under the Astrolabe; which threed, if (while the Astrolabe hangeth immoveable) it fall just upon the line D E, then is the Astrolabe well rectified: If not, you must continue cutting off some thing, and lightning that side towards which the threed doth fall, until it hang even with the foresaid line. Then must you draw upon a Ruler of the same matter, (being about a finger and an half broad) the right line H I along through the very midst of the breadth thereof: which Ruler shall be made after the same fashion that here is set down, cutting away from one half of the length half of the breadth, alwayes saving whole the line H I. And so likewise shall you cut off along the half of the length on the contrary part, half of the breadth; so that the line H I may remain whole on that side also. And neer to the ends of the said Ruler, you shall set two little square Vanes of the breadth of the Ruler in the midst standing upright, the very midst of both Vanes being placed upon the line H I. Through the centers of which two Vanes shall be made two little holes, both which must stand directly over the line H I, and in equal distance from the upper face of the Ruler. This Ruler by a hole bored thorow the midst thereof, shall be fastened upon the said Astrolabe through another hole of the bigness of that in the Ruler, at the very center A with a nail, which may be made fast with a little pin, as is to be seen in the figure.

Chap. II.

Of the heighth of the Sun.

TO take the heighth of the Sun, you must hold the Astrolabe by the ring or knot D, in your left hand: and turning your right side to the Sun, lift up the Ruler with your

right hand, till the beam of the Sun entring by the hole of the uppermoſt Vane, doth alſo pierce thorow the hole of the nethermoſt Vane. And then note the degree and part of the degree which the line H I doth touch, for that is the heighth of the Sun above the Horizon; which if it be the greateſt heighth that the Sun hath that day, it will teach us how far we are diſtant from the Equinoctial. This greateſt heighth is to be taken at mid-day, lifting up the uppermoſt Vane, till we be aſſured that the Sun ceaſeth to riſe any higher, but beginneth to fall again. Then note that greateſt heighth, and keep it for the making of your account of the Latitude by the Sun.

CHAP. III.

Of the Shadows.

THe ſhadowes being compared with the Sun, may be of three ſorts, for at high noon the ſhadow falleth either towards that part of the World to which the Sun declineth, or towards the contrary part, or elſe we make no ſhadow at all. The firſt and ſecond ſort are, when the heighth of the Sun is leſſe then 90 degrees, and the third is, when it is juſt 90 degrees high. The firſt is, when the Sun keepeth his courſe on the North ſide of the Equinoctial, which is from the 11 of *March* to the 13 of *September*; and likewiſe when the ſhadows fall towards the North of the Compaſſe: or when the Sun runneth on the South ſide of the Equinoctial (which is from the 14 of *September* to the 10 of *March*) and the ſhadows likewiſe fall towards the South of the Compaſſe: and this is when the Sun and the ſhadows go both one way. The ſecond is, when the Sun coming towards the North, the ſhadows are caſt towards the South of the Compaſſe; or when the Sun is on the South ſide of the Equinoctial, the ſhadows fall towards the North; and this is, when the Sun and the ſhadows are differing.

The rule of the ſhadowes is, that we look well to the lower Vane of the Aſtrolabe, when we are taking the height of the Sun at noon: For if the line H I fall directly upon the line of the Aſtrolabe D E, then we have no ſhadow, becauſe the Sun is in our Zenith 90 degrees high. But if the line H I fall not upon the line D E, you muſt mark towards what part of the World the lower part of the Ruler doth decline from the point E; which if it decline towards the North of the Compaſſe, then the ſha-

dowes

dowes fall Northwards. But if it decline towards the South of the Compaſſe, then the ſhadows fall Southwards.

Chap. IIII.

Of the Regiment and Rules of the Sun.

WHen you know the part or parts of the Sun and ſhadows and deſire by the Sun to know how far you are diſtant from the Equinoctial, you have five rules: The firſt whereof ſheweth in what part of the Heavens the Sun is, that is, whether he be North or South from the Equinoctial at the time of your obſervation. The ſecond teacheth what account we are to take of the Sun, when he caſteth no ſhadow, becauſe he is in our Zenith and is found in the Aſtrolabe to be juſt 90 deg. high. The third is of the account to be made by the Sun, when taking the height thereof in leſſe then 90 degr. it maketh a ſhadow at high noon, and hath no Declination, becauſe it is under the Equinoctial. The fourth is, of the account that is to be made, when the Sun and the ſhadows are both one way from the line. The fifth is when the Sun and the ſhadows are different on, being towards the North, and the other towards the South.

The firſt Rule of the Sun.

From the 11 of *March*, to the 13 of *September*, the Sun runneth on the North ſide of the Equinoctial. And from the 14 of *September* to the 10 of *March* he goeth on the South ſide thereof.

The ſecond Rule of the Sun.

When we obſerve the Sun in 90 degrees of height, we muſt ſee what degrees and minutes of Declination the Sun hath the ſame day: And then we may ſay that we are ſo much diſtant from the Equinoctial towards that part of the world to which the Sun declineth.

The third Rule of the Sun.

When the Sun is leſs then 90 degrees high, if there be no Declination the ſame day, then ſo much as it wanteth in height of 90 degrees, ſo much are we diſtant from the Equinoctial, towards that part of the world towards which the ſhadow falleth.

The fourth Rule of the Sun.

When the Sun and the ſhadowes are both towards the ſame part of the world, we muſt note how much the Sun wanteth of 90 degrees in heighth; And that which it wanteth (being added to the Declination of the Sun the ſame day) is our juſt diſtance from the Equinoctial towards that part of the world to which the Sun and ſhadowes decline.

The fifth Rule of the Sun.

When the Declination of the Sun and the ſhadowes be different, we muſt add the height of the Sun unto the Declination which it hath the ſame day: And if the Sun amount to 90 degr. juſt, then are we under the Equinoctial line: but if it exceed 90 degrees, we are ſo much diſtant from the Equinoctial towards that part of the world wherein the Sun is, as that exceſſe or overpluſs commeth to. And if the heigth and Declination added together come to leſſe then 90, look how many degrees and minutes you want of 90, ſo many are you diſtant from the Equinoctial towards that part to which the ſhadowes fall.

And here is to be noted that we muſt likewiſe make account of the minutes, becauſe they may be both in Declination, and in heigth, and ſo alwaies in that Declination where we ſhall find 60 minutes, we muſt make of them one degree And if in taking the heighth we find half a degree beſides all the whole degrees, it is as much as 30 minutes, and one third part of a degree is 20 minutes, one fourth 15 minutes, one fifth part 12 minutes, and one ſixth part 10 minutes.

CHAP. V.

Of the Declination of the Sun, and of his Tables.

THat wee may know what uſe to make of the five foreſaid Rules of the Declination of the Sun, we are to note, that the year (which is the time of the Suns motion from any point of the Ecliptick till he return again to the ſame point) conſiſteth not alwaies of an equal number of days. For beſides 365 days it containeth almoſt one quarter of a day: but the year which we commonly account containeth 365 days

days in common years, and in leap years 366. It was therefore needfull to make foure Tables of twelve moneths apeece (whereof the three first contain 365 days, and the fourth 366) and in such sort to distribute the Declination of the Sun among them, that you may make account of the Declination which is wanting to the Sun at the end of 365 days, for lack of those six hours almost which the Sun wanteth to come unto the point, from which it departed at the begining of the year: and also of the Declination which resulteth in the fourth year, because it consisteth of 366 days, at what time it cometh to recover that which in the three former years it had lost. Therfore to know at all times which of the foure Tables we ought to make use of, I will set down a Rule whereby you may know whether the present year be leap year, or whether it be the first, second or third year after the leap year.

And the Rule is this, that taking from the years of our Lord (which run in our common account) the number of 1600, if the remainder thereof be an even number, and half of the remainder an even uumber, then that year is leap year: and if the remainder be even and the half thereof odd, then that year is the second year after the leap year. But if the remainder of the years numbred be odd, we must try the year next going before, to see whether the remainder thereof and half the remainder be even numbers, for then the present year is the first after the leap year. And if the remainder of the year going before be even, and the half thereof odd, then the present year is the third year after the leap year.

How the Declination of the Sun may be found out.

Now to know the Suns Declination every day, we must look in that Table which answereth to the present year, and seeking the moneth in the upper part of the page, and the day of the moneth wherein we would know the Declination, in the column which descendeth towards the left hand; right over against the said day, and under the title of our moneth, we shall find two numbers; one of degrees, and the other of minutes; which are the Declination of the Sun that day towards that part of the world which the first Rule of the Sun doth teach.

CHAP. VI.

The Equation of the Suns Declination

THey which ſail in the moneth of *Iune* and *December*, need not much to make any Equation, in the Table of the Suns Declination, becauſe that in thoſe moneths the Declination of one day differeth very little from the Declination of another. But at all other times of the year we ought to make ſome kind of Equation to know precisely our height, or our diſtance from the Equinoctial. This Equation is to be made after this manner: You muſt ſubtract the Declination of the Sun for the preſent day from the Declination of the day following, or contrariwiſe (ſubtract alwaies the leſſe out of the greater) and the difference, or remainder ſhall be multiplied by the leagues which our ſhip hath ſailed from the Meridian of *London*; and the product of the multiplication muſt be divided by * 7200 leagues, which are contained in the compaſſe of the whole earth: then (if you have ſailed Weſtward, the Quotient muſt be added to the Declination of the Sun that day, if it be from the 11 of *March* to the 12 of *Iune* or from the 13 of *September* to the 12 of *December*: or it muſt (if the ſhippe alſo hath ſailed VVeſtward) be ſubtracted if you find it in any other time of the year, except in the daies of the *Equinoctium*, for then this difference is known by taking the Declination of the preſent day with that of the day following: but if you be to the Eaſtward from the Meridian of *London*, you muſt doe contrariwiſe, ſubtracting the ſaid Equation where before you added it.

These leagues muſt be counted in the Equinoctial betweene the meridians of the two places. But it were better to find the difference of Longitude: for then as 360 degrees are to that difference ſo is the difference of Declination to the Equation deſired.

In ſtead of the Table of the Suns Declination here inſerted by Roderigo Samorano, *uſe the Table before ſet down from the* 174 *page, to the* 180 *page.*

CHAP. VII.

Foure examples for the plainer declaration of that which is ſaid before.

An example of the ſecond Rule.

IN the year 1608 the 15 of *April*, ſuppoſe I was ſailing, and took the height of the Sun with my Aſtrolabe at noone, and found the height thereof to be juſt 90 degrees. Firſt therefore I took from 1608. the number of 1600. and their re-

main 8 which remainder being an even number, and foure the half thereof being even alſo, I ſay the year 1608 is the Leape year. And ſo I goe unto the fourth year in the Table of the Suns Declination, which is leap year, and under the moneth of *April*, over againſt the 15 day, I find 13 degrees and 25 minutes 41 ſeconds: I ſay therefore that I am diſtant from the Equinoctial towards the North 13 degrees and 26 minutes almoſt, becauſe it is betwen the 11 of *March* and the 13 of *September*, in which ſpace falleth the 15 day of April.

The ſecond example of the third Rule.

In the year 1602 upon the 13 day of *September*, admit I tooke the height of the Sun, and found it in my Aſtrolabe to be 70 degrees and an half: and that in the Table of Declination belonging to the ſame year, upon the foreſaid day of *September*, I found that the Sun had no declination, but that it was under the very Equinoctial line. Now becauſe the degrees of the height which the Sun wanteth of 90 are 19 and an half, I ſay that I am ſo much diſtant from the Equinoctial toward that part of the world unto which the ſhadow falleth.

Example of the fourth Rule.

Upon the 13 of *May* 1609 ſuppoſe I took the height of the Sun at noon in my Aſtrolabe, and found it to be 85 degrees and three quarters. Now becauſe 1609 is an odde number. I goe back to the former year of 1608. and I find (according to the Rule of leap years) that the year 1608 is leap year; and hence I judge that the year 1609 is the year next following the leap year.

Then I go to the Tables of Declination belonging to the firſt year after the leap year, and under the moneth of *May* againſt the 13 day, the Suns Declination is found to be 20 degrees, 41 minutes, 15 ſeconds; and becauſe that from the 11 of *March* to the 13 of *September* the Sun keepeth his courſe to the Northwards of the Equinoctial, having marked the ſhadow at midday, I ſee that the lower vain of mine Aſtrolabe, looketh to the North of the Compaſſe, and ſo I ſay that the Sun and the ſhadow are both one way. Then I look for the height which is 85 degrees, and three quarters, ſo that it lacketh of 90 degrees four degrees and one quarter, which is fifteen minutes, Theſe four degrees and fifteen

fifteen minutes being added to the Declination, which is twenty degrees and 41 minutes, amount in all to 24 degrees and 56 minutes: And so much am I distant from the Equinoctial towards the North, which is the part of the Sun and of the shadowes.

An example of the fifth Rule.

Upon the 17 of *October* 1609 which is the first year after the leap year) the Sun now going his course towards the South, suppose I took his Altitude in 50 degrees and one third. And when I took it, the lower vain of mine Astrolabe Declined toward the North of my Compasse: wherefore I say that the Sun and the shadowes are different. And so adding 05 degrees and 20 minutes (which is one third part of a degree) with 12 degrees and 55 minutes (which upon that day is the Suns Declination) they amount in all to 63 degrees and 15 minutes: which are lesse then 90 degrees by 26 degrees and 45 minutes: and so far am I distant from the Equinoctial to the part of the shadowes, that is, to the North: for the Sun and shadowes being different, the heigth and Declination came not to 90 degr.

A second example of the fifth Rule.

The same day and year suppose that some man found the Sun in 77 degrees and five minutes of heighth, the Sun it self declining to the South, and the shadowes falling to the North; which being added to 12 degrees and 55 minutes of Declination, amounteth in all to 90 degrees, just: whereby I know that the ship wherein this Altitude is taken, is under the Equinoctial: because the Sun and shadowes being different, the heigth and Declination make just 90 degrees.

The third example of the fifth Rule.

Upon the 20 of *May* 1608, suppose a certain man found the Suns heighth to be 88 degrees and two third parts, the Sun and shadowes being different: which being added to 21 degr. 54 minutes, (the Suns Declination that day) amounteth to 110 degrees 34 minutes, which exceed 90 by 20 degrees and 34 minutes. I say therefore that this man is 20 degrees 34 minutes distant from the Equinoctial, towards the part of the Sun, which is to the North, because the Sun and the shadowes being diffe-

rent

rent, the heigth of the Sun, and the Declination being added to gether exceed 90 degrees.

Chap. VIII.

Another manner of accounting by the Sun, as they uſe in Portugall.

Some Aſtrolabes there bee, whoſe account beginneth not from the Horizon, but from the Zenith, and endeth with 90 degr. in the Horizon; and the heigth taken by them is nothing elſe but the diſtance of the Sun from our Zenith: And to make an account of the Sun, according to the Altitude, taken with ſuch Aſtrolabes, there are theſe Rules following to be Obſerved,

1. When the Sun and the ſhadows are both one way, add the heighth unto the Declination, and the product will ſhew how far you are diſtant from the line, towards the part of the Sun and ſhadows.

2. If the Sun and the ſhadow be differing, ſubduct the Declination from the height, or the height from the Declination (the leſſer from the greater) and the remainder will ſhew how far you are from the line, towards the part of that which is greater: and if the height be greater, then are you on the part of the ſhadowes.

3. When the Sun is in the line and hath no Declination, ſo much altitude as you ſhall find, ſo far are you diſtant from the Equinoctial towards the part of the ſhadowes.

4. When you ſhall take the Sun in your Zenith, having then no altitude, his Declination will ſhew you how far you are diſtant from the line towards the part of the Sun.

Theſe Rules, becauſe they are ſo eaſie and plain, need no examples.

Chap. IX.

How the height of the Sun may be known in any place whatſoever without an Aſtrolabe; firſt knowing your diſtance from the Equinoctial.

Some Pilots for their curioſities ſake deſire to know the height of the Sun for any day without an Aſtrolabe. For the

performance whereof, it is expedient, that they know three things: that is to say, the Declination of the Sun, the distance of the place from the Equinoctial, and the part whereunto the shadows do incline at mid-day. These three things being known, you shall come to the knowledge of the Suns heighth by four Rules.

1 When you and the Sun be both on one side of the Equinoctial, if your distance from the line be equal to the Suns declination, you shall finde the Sun in your Zenith in 90 degr. and shall have no shadow.

2 When the Sun hath no declination, look how much your distance from the Equinoctial wanteth of 90 deg. for so much is heighth of the Sun.

3 When the Sun and the shadows are both towards one part, subtract out of your distance from the Equinoctial the Declination of the Sun that day, and that which the remainder shall want of 90 deg. shall be the heighth of the Sun.

4 VVhen the Sun and the shadows are different, if the Equinoctial be between you and the Sun, adde the Declination of the Sun to your distance from the Equinoctial, and that which these two numbers added together shall want of 90 deg. shall be the heighth of the Sun. But if you be between the Sun and the line, you must subduct your distance from the line out of the Suns Declination, and then that which the remainder shall want of 90 deg. shall be the heighth of the Sun.

Chap. X.

The Rule or Regiment of the North-star, for the knowledge of the heighth of the Pole.

THe Zenith is the Pole of the Horizon, because it is every where distant from it just 90 deg. And hence it is, that the Pole of the World is so much elevated above our Horizon. as our Zenith is distant from the Equinoctial, which is very manifest: for having 90 deg. of the Meridian from our Zenith by the Pole of the World to the Horizon; and other 90 deg of the Meridian from the Pole of the World, by our Zenith to the Equinoctial; because they are two quadrants of one and the same Circle, they must needs be of equal quantity: from both which that part being taken away, which is common to both (that is, the whole distance from the Pole of the world to our Zenith)

Zenith) that which remaineth on both parts ſhall be equal. And ſo that ſpace from our Zenith to the Equinoctial (which is called the diſtance from the line) is equal to the diſtance that is between the Pole of the World and the Horizon, which is called the heighth of the Pole.

VVhereby it is manifeſt, that the heighth of the Pole is ſo much as our diſtance from the line is. And although they are two different things yet the one is taken for the other, becauſe they are equal.

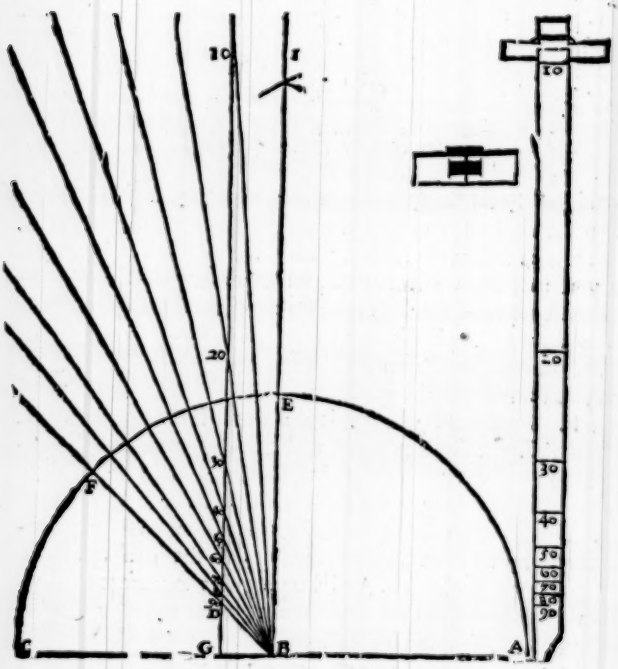
This heighth of the Pole is known by the help of four things, which are the *Baſtoſtilla*, or Croſſe-ſtaffe, the poſition of the North-ſtar, the heighth of the ſaid ſtar, and certain Rules.

Chap. XI.

The making of the Croſs-ſtaff.

THe Mariners Croſſe-ſtaff is that which by the Aſtronomers is called *Radius Aſtronomicus*: and the manner how to make it is as followeth: Firſt, upon a very plain and broad table you may draw a ſemicircle, which from the center to the circumference muſt contain at the leaſt four hand breadths. And having drawn thorow the center thereof the line A B C, divide the circumference into two equal parts, in the point E, as likewiſe you muſt divide the quadrant E C in the very midſt by the point F. Then muſt you divide the arch E F into 90 equal parts, dividing it firſt into three, and every of theſe three into other three, and every of thoſe nine into two, and each of thoſe two into five, which you muſt do with much preciſeneſſe and care. Then laying your Ruler to the point B (which is the center) through every one thoſe 90 diviſions of the half quadrant, you muſt draw 90 lines: And keeping this quadrant ſo divided, it will ſerve you for a pattern to make as many Croſſe-ſtaves as you think good, of what bigneſſe ſoever you will. But to make the Croſſe-ſtaff, you muſt take a piece of wood of ſome three foot in length, and a finger thick, four ſquare, and very even: and fitting a tranſverſary thereto, which may with facility ſlide up and down upon the ſtaff, alwayes right acroſſe; take with your compaſſes half the length of the tranſverſary, and placing one foot of the compaſſes upon the point B, make with the other a mark in the line B C, which may ſerve for the point G, and draw thorow the point G the line G I, which may run

equally diſtant from the line E B. Finally, laying one end of the ſtaff upon the point G, let it lie all along juſt upon the line G I, and make your marks upon the edges of the ſtaff, by which you may draw 90 lines, putting the number of every line upon the ſaid edge, begining to place 90 where the line B E doth croſſe the ſtaff, and from thence deſcending unto one or two, which may be put down according to the length of the ſtaffe, and the largeneſſe of the tranſverſary.



CHAP. XII.

Of the poſition of the North-ſtar, and the Guards.

AMongſt the 48 Conſtellations, which the Aſtronomers place in the Heavens, the neereſt unto the pole of the World is that

that which they call the leſſer Bear, and the Mariners *Bozina*, or the horn, in regard of the faſhion thereof: which Conſtellation conſiſteth of 7 ſtars, which are placed after this manner: And of theſe ſtars, the three greateſt, marked with the letters A B C do ſerve eſpecially for our purpoſe. And ſo A is called the North-ſtar, B the the formoſt guard, C the other guard behind. And they are ſo called, becauſe that by force of the motion of the firſt moveable Heaven, the ſtar B goeth alwayes before, and the ſtar C behind. Every of theſe three ſtars as well as all others in the Heavens beſides, deſcribeth it circles round about the pole with the motion of the firſt or higheſt moveable Heaven: in which motion, ſometimes the two ſtars A B are juſt of one height above the Horizon: and then they are ſaid to be Eaſt and Weſt one from another. Sometimes they are in a perpendicular line to the Horizon, according to our ſight; and then they are ſaid to be North and South: and ſometimes alſo the two guards B C are Eaſt and Weſt one from another. and then the former guard beareth from the North-ſtar, North-eaſt and South-weſt. And when theſe two guards be in a perpendicular line one above another, the former guard beareth from the North ſtar North-eaſt and South-weſt. Inſomuch that from theſe four poſitions do ariſe eight rules for the eight Rumbs, wherein the former guard may ſtand, being conſidered in reſpect of the North ſtar. And ſo preſuppoſing that the North ſtar is diſtant from the Pole three degrees and an half: (according to the opinion of ſome Mariners, who love numbers that have not any fractions) ſometime the North ſtar ſhall be as high as the Pole it ſelf, ſometime three degrees and an half lower or higher then the Pole, and ſometime three degrees, and ſometimes one and an half, and ſometimes half a degree.

B * C *

* *

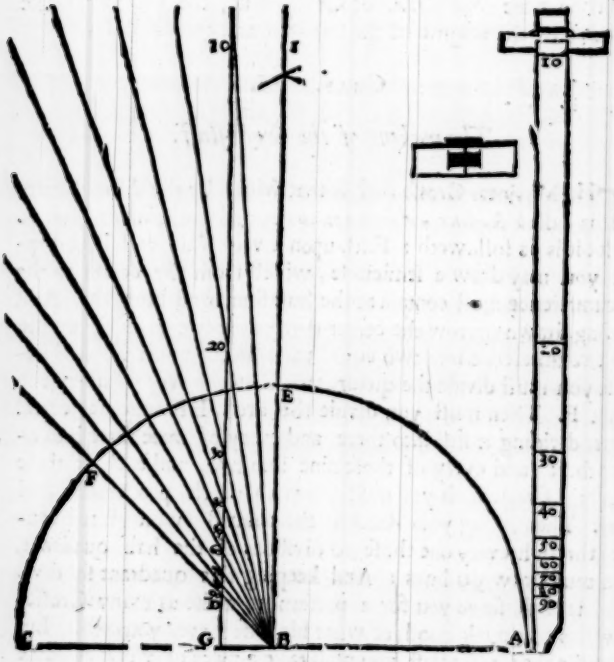
*

*

* A

* D

equally distant from the line E B. Finally, laying one end of the staff upon the point G, let it lie all along just upon the line G I, and make your marks upon the edges of the staff, by which you may draw 90 lines, putting the number of every line upon the said edge, begining to place 90 where the line B E doth crosse the staff, and from thence descending unto one or two, which may be put down according to the length of the staffe, and the largenesse of the transversary.



CHAP. XII.

Of the position of the North-star, and the Guards.

AMongst the 48 Constellations, which the Astronomers place in the Heavens, the neerest unto the pole of the World is that

that which they call the leſſer Bear, and the Mariners *Bozina*, or the horn, in regard of the faſhion thereof: which Conſteilation conſiſteth of 7 ſtars, which are placed after this manner: And of theſe ſtars, the three greateſt, marked with the letters A B C do ſerve eſpecially for our purpoſe. And ſo A is called the North-ſtar, B the the formoſt guard, C the other guard behind. And they are ſo called, becauſe that by force of the motion of the firſt moveable Heaven, the ſtar B goeth alwayes before, and the ſtar C behind. Every of theſe three ſtars as well as all others in the Heavens beſides, deſcribe their circles round about the pole, with the motion of the firſt, or higheſt moveable Heaven: in which motion, ſometimes the two ſtars A B are juſt of one height above the Horizon: and then they are ſaid to be Eaſt and Weſt one from another. Sometimes they are in a perpendicular line to the Horizon, according to our ſight; and then they are ſaid to be North and South: and ſometimes alſo the two guards B C are Eaſt and Weſt one from another. and then the former guard beareth from the North-ſtar, North-eaſt and South-weſt. And when theſe two guards be in a perpendicular line one above another, the former guard beareth from the North ſtar North-eaſt and South-weſt. Inſomuch that from theſe four poſitions do ariſe eight rules for the eight Rumbs, wherein the former guard may ſtand, being conſidered in reſpect of the North ſtar. And ſo preſuppoſing that the North ſtar is diſtant from the Pole three degrees and an half: (according to the opinion of ſome Mariners, who love numbers that have not any fractions) ſometime the North ſtar ſhall be as high as the Pole it ſelf, ſometime three degrees and an half lower or higher then the Pole, and ſometime three degrees, and ſometimes one and an half, and ſometimes half a degree.

CHAP. XIII.

Of the heighth of the Star taken with the Crosse-staffe.

TO know how much the North Star is elevated above the Horizon, you must take the heighth thereof onely at such times when as in respect of the former guard it is in some one of these four Rumbs, that is to say, North and South, East and West, North-east and South-west, and North-west and South-east. Wherefore seeing it placed in any of the foresaid Rumbs, you shall put that end of the Crosse-staffe which is next 90 degrees upon your cheek-bone, at the utter corner of your eye: and holding it there stedfast, you must move the transversarie till you see the Horizon joyned with the lower end thereof; and the North Star with the higher end. Then mark the degree, and part of the degree which the transuersarie sheweth upon the staffe; for that is the heighth of the Star.

CHAP. XIIII.

The regiment or Rules of the North Star.

The first Rules.

WHEN the guards are in the East, the former guard beareth with the North Star East and West, and then the North Star is a degree and half under the Pole: let us add this degree and half to the height which we Observed with the Crosse-staffe; and the whole product sheweth the number of degrees which the Pole is elevated above our Horizon. And so much are we distant from the Equinoctial toward the North.

The second Rule.

When the guards are in the North-east, one guard beareth from another East and West: and the former guard standeth from the North Star North-east and South-west; and then the North Star is under the Pole three degrees and one half; which being added to the height of the Star, will shew you the height of the Pole.

The

The third Rule.

When the guards be at the higheſt, then the former guard beareth from the North Star North and South; the North Star being then three degrees under the Pole: which three degrees being added to the height of the Star, do ſhew the true height of the Pole.

The fourth Rule.

When the guards are in the North-weſt, they bear one from another North and South, and the former guard lieth from the North Star North-eaſt and South-weſt: and then the North Star is under the Pole half a degree: which half degree being added to the heighth of the Star, giveth you the heighth of the Pole.

The fifth Rule.

When the guards are in the Eaſt, the former guard lieth from the North Star Eaſt and Weſt, and then the North Star is a degree and an half above the Pole; which degree and an half being deducted out of the heighth of the North Star, the remainder is the juſt heighth of the Pole.

The ſixth Rule.

When the guards are in the South-weſt, one beareth from another Eaſt and Weſt, and the former lieth from the North Star North-eaſt and South-weſt, and then the North Star is above the Pole three degrees and an half: which three degrees and an half being deducted out of the heighth of the Star, that which remaineth ſhall be the heighth of the Pole.

The ſeventh Rule.

When the guards are at the loweſt, the former guard beareth with the North Star North and South: and then the North Star is above the Pole three degrees; which being deducted, the remainder is the heighth of the Pole.

The eight Rule.

When the guards are in the South-eaſt, one beareth from another North and South, and the former beareth from the North

ſtar

Star North-west and South-east, and the North Star is above the Pole half a degree: which half degree being deducted from the heighth of the Star, the remainder is the heighth of the Pole above our Horizon, and just so much are we distant from the Equinoctial towards the North.

This is the account which alwaies hath bin made of the North Star from the time that it hath had three degrees and an half distance from the Pole unto this present. But because at this time by reason of the compound motion of the 8 and 9 heavens, the fixed Stars have notably varied from their places the Pole Star hath also approched neerer the Pole, being now distant therefrom not above three degrees and eight minutes. And so I think it convenient to set down the account which ought now to be made thereof, according to the foresaid distance: to the end that from henceforth the heighth of the Pole taken by the Star may agree justly with the distance from the Equinoctial taken by the Sun. Which two things have hitherto disagreed and caused no small confusion unto the Pilots, and some error in Navigation.

In stead of all these Rules of the North Star (which are erroneous) use the Tables of Equations of the Pole Stars heighth, set down in the latter end of this book.

The	East,	you shall adde	1 degree 20 minutes
guards	North-east,	unto the heighth	3 degrees 8 minutes
being	North,	taken by the	2 degrees 41 minutes
in the	Northwest,	Crosse-staffe,	0 degree 27 minutes

In the contrary Rumbs to these you must deduct these degrees from the heighth of the Star, which you take with your Crosse-staffe, and then you shall have the heighth of the Pole above the Horizon.

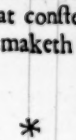
CHAP. XV.

Other things to be noted in Observing the heighth of the Pole.

NEXT unto the constellation of the Horn, here is a Star which is called by the *Spaniards el Guion* signified before by the letter D, which standing East and West from the North-star, giveth you to understand, that it and the North Star, and the very Pole are East and West. And so taking the heighth of the North Star, when it is thus situate in regard of the *Guion*, with out making any other account, you have the just heighth of the Pole, and the distance from the Equinoctial.

Some

Sometimes alſo it falleth out, that being very neer unto the line, or for ſome other cauſe, the guards cannot be ſeen how they lie from the North ſtar. For remedy whereof there are three ſtars, by which (ſeeing any of them and the North ſtar, albeit you cannot ſee the guards) you may know the heighth of the pole, and theſe are ſtars which the Mariners call the third, ſixth, and the ninth. The third is the head of that conſtellation which the Aſtronomers call the Dragon, and it maketh with two other ſtars that follow it, this figure: The ſixth is the right foot of *Cepheus*: and the ninth is the left foot. The third was ſo called, becauſe it commeth unto every third rumb three hours after the former guard; and the ſixth is ſo called, becauſe it cometh ſix hours after the former guard; and the ninth, becauſe it cometh nine hours after the former guard. Whereof it followeth, that when the third ſtar is directly above the North ſtar, the former guard is in the Northweſt, the ſixth ſtar in the Northeaſt, and the ninth in the Eaſt. And to know this in the other rumbs, you may peruſe the Table following; wherein is manifeſtly ſet down where the guards are, and how they are ſituate, in what rumb ſoever any of theſe three ſtars is found. So that it will be an eaſie matter to know the place of the guards, and the heighth of the pole, the heighth of the Pole ſtar being found, and the place of the third, ſixth, or ninth ſtar.



Here followeth the Table.

The guards being in the	The third ſtar is in the	The ſixt ſtar in the	The 9th ſtar in the
Eaſt	*Southeaſt*	*South*	*South weſt*
Northeaſt	*Eaſt*	*Southeaſt*	*South*
North	*Northeaſt*	*Eaſt*	*Southeaſt*
Northweſt	*North*	*Northeaſt*	*Eaſt*
Weſt	*Northweſt*	*North*	*Northeaſt*
Southweſt	*Weſt*	*Northweſt*	*North*
South	*Southweſt*	*Weſt*	*Northweſt*
Southeaſt	*South*	*Southweſt*	*Weſt*

In this Table, the firſt column ſerveth for the guards; the ſecond for the third ſtar; the third column for the ſixth ſtar; and the fourth for the ninth ſtar. Inſomuch as if you ſeek the rumb, ſeeing any of theſe four ſtars in this Table, right againſt the ſame do anſwer thoſe rumbs where the other three are, although we cannot ſee them in the Heavens.

CHAP. XVI.

Of the Croſiers.

WHen the Mariners paſs the Equinoctial line towards the South, ſo that they cannot ſee the North-ſtar, they make uſe of another ſtar, which is in the Conſtellation, called by the Aſtronomers the *Centaur*, which ſtar, with other three notable ſtars, which are in the ſame Conſtellation, maketh the figure of a Croſſe; for which cauſe they call it the *Croſier*. And it is holden for certain, that when the ſtar A (which of all four commeth neereſt to the South Pole) is North and South with the ſtar B, that then it is rightly ſituate to take the heighth by. And becauſe this ſtar A (which they call the Cocks foot) is thirty degrees from the South Pole, it cometh to paſſe, that if being ſituate, as is aforeſaid, we take the heighth thereof (which is then the greateſt that it can have) this heighth will truly ſhew how far we are diſtant from the Equinoctial. For if the ſaid heighth be thirty degrees, then we are in the very Equinoctial: and if it be more then thirty degrees, then are we by ſo much paſt the Equinoctial towards the South. And if it be leſſe then 30 degrees, ſo much as it wanteth are we to the North of the Equinoctial.

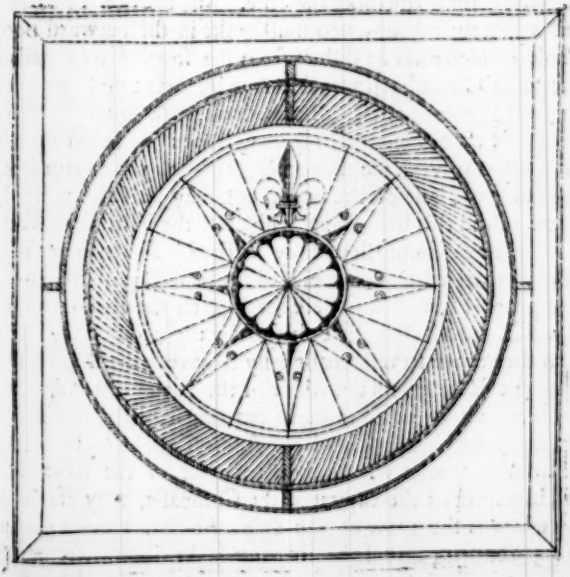
And here it is to be noted, that when the guards are in the North-eaſt, then are the ſtars in the Croſier fitly ſituate for obſervation, becauſe then they are in the Meridian.

CHAP. XVII.

Of the Sea-Compaſs.

THe Sea-Compaſs is one of the moſt neceſſary Inſtruments, which are uſed in Navigation; for day and night, in clear and dark weather it ſheweth always the right way through the Sea. And therefore it is meet that this Inſtrument be made with much care; to the end, that it may be moſt certain and true.

true. And the manner of making it is, that upon a piece of paſt-board, you draw a circle ſo big as you will have your Compaſſe to be, which being divided into 32 equal parts (as we have already ſhewed in the Chapter of the winds) with ſixteen lines croſſing one another in the center, then you ſhall adorn the eight principal winds, as is to be ſeen in the figure following, ending in the North with a Flower deluis: and you ſhall paint the North and South, and Eaſt and Weſt with blew, and the North-eaſt and South-weſt, and the North-weſt and South-eaſt with red. And then taking two ſteel wires, which are to be placed like the head of a launce, you muſt faſten them on the back ſide of the ſaid circle, in ſuch ſort, that one meeting of the points of thoſe ſteel wires be right under the North, allowing half a point towards the North-eaſt, in regard of the North-eaſting of the needle at *Sevil*: and the other meeting at the oppoſite point, which is South, and half a point towards the South-weſt: and touching or rubbing thoſe two points of the wires with the ends of the Load-ſtone, which look to the North and to the South, to wit, the North points of the wires, with the South of the



ſtone: & the South point of the wires with the North of the ſtone This being done, you muſt place upon the center of the ſaid circle a Capitel, which muſt be very well bored in, from off a round pyramis; to the end, that the roſe or fly may play more nimbly upon the pin. This pin muſt be made of lattin, with a very ſharp point, and is to be faſtned upright in a round box of wood, which muſt be of the faſhion of a great cup-diſh, containing the roſe within it, being covered above with a clear round glaſſe, and the joynts thereof muſt be ſtopped with wax, to the end, that no wind may enter into the roſe to diſturb it. There muſt be great care had, that this roſe, with the wires placed upon the pin, may go nimbly, and may not ſwerve more to the one ſide then to the other, but may ſtand even and level. And when it inclineth towards either part, you muſt put on the contrary part a little wax, or a thin plate of lead faſtened under the paſtboard, which covereth the wires. This box wherein the roſe plaieth up and down hangeth within two hoops of lattin, which are two round circles incloſed one within another, and diſtant aſunder by the ſpace of half a fingers breadth, with two nails of lattin, which are diametrally oppoſite. And the box being fitly placed within theſe hoops, you muſt make in the outward hoop two holes, which muſt be diſtant from the foreſaid two nails a quarter of a Circle both wayes: And by theſe two holes muſt the outward hoop or circle be faſtened within a ſquare box, or a round, ſo as although that uttermoſt box be toſſed up and down every way with the motion of the ſhip, yet alwayes the ſuperficies and glaſſe of the inner box may lie level with the Horizon. And this being done with care, the inſtrument, which they call the Sea-Compaſſe is fully finiſhed. The manner of uſing the ſame is, when being placed with the box in the midſt of the poop of the ſhip where the bittacle ſtandeth in a right line, which paſſeth from the bolt-ſprit by the midſt of the main maſt to the poop, it ſerveth continually to govern the ſhip by moving of the Rudder, till the winde or the line of your Compaſs, towards which we deſire to ſhape our courſe, ſtand directly towards the prow or bolt-ſprit of the ſhip. They uſe alſo for the night to mark a point within the inner part of the inner box, which in reſpect of the capitel of the Compaſſe, may ſtand directly towards the prow of the ſhip. And alwayes in guiding the ſhip, you muſt take heed that the ſaid point be continually joyned with the winde of the roſe towards which you intend your courſe.

CHAP.

Chap. XVIII.

How the Variation of the Compaſſe may be found.

THe Mariners uſe to examine whether their Compaſs North-eaſteth or South-weſteth, watching for that purpoſe when the former guard beareth with the North ſtar North-eaſt and South-weſt, taking a little of the point of North and South. And placing their Compaſſe in an open place, where the North ſtar may be ſeen, if the flowerdeluis of the Roſe looketh directly towards the ſtar, their Compaſſe varieth nothing at all: but if the ſtar be to the North-eaſt, ſo much as it varieth from the point of the flowerdeluis, ſo much the Compaſs North-weſteth: and if it varieth to the North-weſt of the Compaſs, how much the ſtar ſwerveth from the point of the flowerdeluis, ſo much the Compaſſe North-eaſteth. And in regard of this variation of the Compaſſe there muſt alwayes allowance be made in the courſe which is holden. This manner of finding out the variation I do account to be ſomewhat ſubject unto errour: but at land there is another more certain way by the Meridian line, which is to be taken in manner following.

The finding of the Meridian-line.

In a ſuperficies, which is plain and level every where, and in a place where the Sun ſhineth at his riſing and ſetting, you muſt draw certain circles upon one center: and having pitched a ſtile upright in the ſame center (the head whereof muſt be approved with a pair of compaſſes to be equally diſtant from all parts of one of thoſe circles) obſerve you in the morning two or three hours before noon, when the point of the ſhadow of the ſtile toucheth the circumference of any of thoſe circles: and having made a mark in the touches, take diligent heed in the afternoon alſo, when the ſame point of the ſhadow turneth about to touch in the ſame circle, and making another mark in that ſecond touch, divide in the midſt that part of the circle which is between thoſe two marks. Then laying your Ruler upon the point of the diviſion, and upon the center of thoſe circles draw a line, which ſhall be your Meridian, and the true North and South Rumb; upon which ſetting your compaſſe, and laying your Ruler over the glaſſe, that it may paſſe along over the

Meridian, and over the center or capitel of the roſe or flie: either the ſaid Ruler lieth over the North and South of the Compaſſe (and then is the Compaſſe without variation) or the Ruler declineth toward the North-eaſt or South-weſt; and how much it declineth that way, ſo much the Compaſſe North-weſteth, or elſe it declineth towards the North-weſt, and then it North-eaſteth ſo much as the Ruler declineth that way. But to know the variation of the Compaſſe both at land and ſea, we will deliver another far more eaſie and certain way, when we come to intreat of the univerſal Dial.

CHAP. XIX

Of the Sea-chart.

THe Sea-chart is nothing elſe but a lively picture of the earth and water. And it containeth five notable things, which do concern as well the true making of the Chart, as alſo the inabling of the Mariner to know the way which he maketh, the place where he is, and the end of his journey.

The firſt is the laying out of the Coaſts of the Land, which that it may be truly done, it is meet that every thing be ſet down in the Chart in the ſame courſe, diſtance, and heighth that ſhall be found in Navigation.

The ſecond is, that it containeth not onely the coaſt of the firm land, but alſo all other particularities which do occur in ſailing, as namely, Iſlands, Iſelets, Banks, or Bars, Shoalds, Rocks, and Flats.

The third is the lines which ſignifie the 32 winds, by the help whereof we may ſee whether the parts of the land be well laid out, and in their true courſes one from another. And of theſe winds the black are the eight principal, which are called whole winds. The green be half winds, or half parted winds: and the red be the quarters of the winds. You may know in your Chart whether theſe winds be well drawn, if you trie with your compaſſes that all points of them be equally diſtant one from another: and that all winds repreſenting the ſame Rumb be parallels: As namely, that one Northeaſt and Southweſt Rumb be parallel to another Northeaſt and Southweſt Rumb. The fourth is the graduation, in all parts, whereof it is meet that the degrees † be equal one to another: and that the parts of the land do directly lie Eaſt and Weſt from thoſe degrees under which

† Or rather increaſed proportionally from the Equinoctial line toward the North & South.

which they are ſituate. The fifth is the ſcale of leagues, which you may ſee whether it be true, by taking betwixt the points of your compaſſes juſt 4 degr. out of the line of graduation which being applied to the ſcale of leagues muſt there agree exactly with 70 Spaniſh leagues or 80 Engliſh.

By the *Sea-Chart* are known five things: The firſt is the lying or trending of the Coaſt. The ſecond is the diſtance or number of leagues from one coaſt to another. The third is, the latitude or diſtance from the Equinoctial, wherein all Lands both Continents and Iſlands, as alſo every Port, River, Iſle, Shoald or Bank is ſituate. The fourth is the rumb or rumbs, by which we are to ſail from one place to another. The fifth is the point or place where we are with our ſhip when we are ſailing. The firſt is known with a pair of compaſſes, putting one foot thereof upon the beginning of the coaſt, whoſe trending we deſire to know, and the other foot upon the rumb, which to our thinking is every where equally diſtant from the ſaid coaſt. For if one foot of the compaſſes running along the Coaſt, the other foot keepeth by the ſaid Rumb, then we ſay the coaſt lieth even with that rumb. And if our compaſſe runneth without ſwerving one foot from the rumb, and the other from the Coaſt, till the point which runneth along the coaſt leaveth it, then from that very place where it leaveth the ſame, we may ſay, that unto the other place where it began, the coaſt runneth by ſuch a rumb, as if a man ſhould ſay Eaſt and Weſt, Northeaſt and Southweſt, or any other rumb whatſoever.

The ſecond thing (which is the diſtance) may be found by taking between the points of your compaſſes out of your ſcale of leagues (if the diſtance be very great) an hundred leagues, and meaſuring with your compaſſe ſo opened from one place to another: now if in ſo doing it falleth not juſt, then remembring how many hundreds of leagues there are, you muſt for the meaſuring of the reſt pitch one foot of your compaſſe upon the point where the laſt hundred ended, and the other foot upon the land whoſe diſtance you deſire to know: then bringing the compaſſe ſo opened to the ſcale of leagues, you ſhall ſee manifeſtly how many leagues the ſaid diſtance ſurmounteth above the hundreds. But if the diſtance be leſſe then an hundred leagues, then ſetting the points of your compaſſes upon thoſe two places whoſe diſtance you deſire to know, and removing the compaſſe ſo opened to the ſcale of leagues, you ſhall eaſily know the diſtance of one of thoſe places from the other.

The

The third (which is the heighth or latitude, wherein every Port, River, or Iſland ſtandeth) is to be found by pitching one foot of your compaſſes upon the Land, Haven, or Cape, whoſe heighth you deſire to know, and the other foot upon the next East and West parallel, and the compaſſe remaining in that ſort, move the point thereof along the ſaid parallel or rumb, to the line of graduation, and there the other foot which lay upon the land will ſhew you the heighth thereof.

The fourth (which is the rumb or rumbs, by which you muſt ſail from one place to another) is known after this manner: If you be to ſail by one rumb only, you may know it, by pitching one foot of your compaſſes upon the place from which you are to depart; and the other foot upon the very next rumb, which to your thinking goeth moſt directly to the place whither you would go; and running by that rumb with one foot of your compaſſe ſo opened, the other foot will touch the place whither you are going. But if it toucheth not the place whither you are going, then pitch one foot of your compaſſes upon the ſame place, and the other foot upon the ſecond rumb, which you ſuppoſe may lead you thither. And placing one foot of another pair of compaſſes upon the place from whence we depart, and the other upon the moſt direct rumb toward the place deſired; theſe two compaſſes running along the rumbs one toward another; you muſt mark where thoſe two points joyn together, one whereof came from the place of your departure, and the other from the place whither you are to go; & the point where they both concur is that to which we are to change our courſe.

As for example, if I ſail from the bar of *S. Lucar*, to fall with *Punta de Naga* upon the Iſle *Teneriffe* in time of winter; it is evident, that I muſt ſail Southweſt and by South, till I bring my ſelf East and West with *Cape Cantin* in 32 degrees and an half: and from thence I muſt go Southweſt and by weſt, but not all the way, becauſe putting one point of the compaſſe upon *Cape Cantin*, and the other point upon the Southweſt and by weſt rumb next unto it, my compaſſe thus running open alongſt the ſaid rumb, the point which departed from *Cape Cantin*, will run on the out-ſide of *Punta de Naga*. But in ſuch a caſe as this I place one point of one pair of compaſſes at *Punta de Naga*, and the other point upon the Southweſt rumb: Likewiſe I place one point of another pair of compaſſes at *Cape Cantin*, and the other upon the next Southweſt and by weſt rumb. Then let theſe two compaſſes ſo opened run by their ſaid rumbs one againſt

gainſt another, and then you muſt look in what place & heighth the very point is, where thoſe two points of the compaſſes which departed from *Punta de Naga* and *Cape Cantin* do meet: and I ſay, that when I am come to the ſaid heighth and place, having ſailed from *Cape Cantin* Southweſt and by weſt, then I muſt change my courſe, and run South-weſt.

CHAP. XX.

Of the point of Imagination.

THe fifth thing to be known by the Sea-chart is the point of the ſhips place, and this they term to call a point, or to ſet a prick upon the chart: which is no other thing but to finde a point therein, which is proportionally diſtant in the Chart from all the Lands and Iſlands there deſcribed ſo many leagues of the ſcale, as there are leagues of diſtance upon the ſea from the place where you are to the Lands and Iſlands round about you, repreſented by theſe that are in the Chart. This point is to be found two wayes; either by imagination, or by traverſing, which may properly be called geometrical. The point of imagination is uſually found by the firſt of theſe two wayes, when we ſail directly by a parallel circle; which is when we ſail due Eaſt and Weſt, keeping alwayes in one heighth and diſtance from the Equinoctial: or when we ſail by any other rumb in cloſe weather, when neither the Sun at noon, nor the North ſtar in the night can be ſeen.

This point doth preſuppoſe the knowledge of two things; to wit, the rumb, by which we have ſailed, and that is known by the Compaſſe, and the leagues which we have run; and this hath no certainty, but is a little more or leſs then a good Mariner, according to his imagination ſuppoſeth that he hath ſailed: whereof the ſaid point tooke his name.

This point is found in the Chart, by taking out of the ſcale of leagues ſo many leagues as a man can well eſtimate that the ſhip hath gone: and pitching one foot of the compaſſe in the place from which you departed, you ſhall ſet the other point in ſuch ſort, that both may be equally diſtant from the Rumb or wind whereby you have ſailed; and where that ſecond point of your Compaſſe ſhall fall, there is your ſhip according to your imagination.

Chap. XXI.

Of the Traverſe or Geometrical point.

THe point found by imagination is not ſo certain as is convenient, becauſe it oft commeth to paſſe, either becauſe the Mariner hath not made true account of the way that his ſhip hath made, or for ſome other cauſes therewith concurring, that if he taketh the heighth by the Sun, or by the North ſtar, after he hath caſt his point, he commeth not to find himſelf in that diſtance from the Equinoctial, which his point of imagination doth ſhew him, but in ſome other diſtance. And to avoid this error there is another way of caſting your point in the Chart, which is called *punto de eſquadria* (the Traverſe point) which point preſuppoſeth the aſſured knowledge of two things; one is the Rumb by which you have ſailed, the other is your diſtance from the Equinoctial.

For all this art of Navigation is grounded upon the courſe, and height, which is in quantity all one with the diſtance from the Equinoctial. The Rumb or courſe is alwaies known by the Compaſſe, the height by the ſtar, and the diſtance from the Equinoctial by the Sun.

This being known, ſet the foot of one Compaſſe at the port or place from whence you departed, and the other foot in the next Rumb where upon you have ſailed: and placing one point of an other paire of Compaſſes upon the line of graduation, in the degree of your diſtance from the Equinoctial, and the other point upon the next Eaſt and Weſt Rumb, let theſe two pair of Compaſſes ſtanding thus open, run along the Rumbs, one towards another, till the point which came from the place of your departure, and that other which came from the height of your graduation meet: and where they meet, there is the place of your ſhip. And this point ſo found out, is moſt certain, when the height is carefully taken, and the Rumb known.

Chap. XXII.

Of the amending of the point of imagination.

HE that knoweth how to find out the point by traverſing, ſhall eaſily amend the point of imagination, when having taken

taken his height he findeth the ſaid point not to be good and certain. And here is to be noted, that when you ſaile East and West and find the point by imagination, this point cannot be amended, but you muſt ſaile in doubt how many leagues you have gone untill you fall with the land; becauſe that ſailing in that courſe neither the height of the pole, nor your diſtance from the Equinoctial, doth any whit alter. But when you ſaile by any other rumb, your point of imagination may be amended, and the amendment thereof ſhall be ſo much the more certain as the rumb of your Navigation cometh neerer to the North or South, and by ſo much the more uncertain as it cometh neerer to the East or West. This amendment is made two manner of wayes, namely, either by traverſing, or by the amendment of North and South and East and West; which ſecond amendment, though it be a kind of traverſing, yet it is called by another name, to diſtinguiſh it from the firſt.

The amendment of the point of imagination by the traverſe point.

When you will amend your point of imagination by traverſing, you muſt ſet one foot of one pair of your compaſſes in the point found by imagination, and the other foot upon the next rumb by which you have ſailed: and ſetting the foot of another pair of compaſſes in the line of graduation upon the number of degrees, which you finde your ſelf diſtant from the Equinoctial, and the other foot upon the next East and West line; run with your compaſſes ſo opened by the foreſaid rumbs, till the point proceeding from the graduation, and the other which proceedeth from the point of imagination do meet juſt together, and then you may ſay, that your point of imagination is mended by traverſing.

The amendment of the point of imagination by North, South, Eaſt, and Weſt.

The amendment by North, South, East, West, is after this manner: Set the foot of one compaſſe upon the point found by imagination, and the other foot upon the next North and South rumb: then place one foot of another compaſs in the line of graduation upon the degree wherein you find your ſelf, and the other upon the next East and West rumb, and ſo let theſe two

compasses run thus open by their rumbs, till the point which cometh from the point of imagination, and the other which cometh from the graduation do meet; for then is your point of imagination amended by the amendment of East, West, North, South.

Of these two amendments the first serveth when you sail in a large gulf, because you may run at liberty with the compass: the second serveth neer unto any coast.

Chap. XXIII.

The point by imagination, and the heighth.

When you sail by the sixth or seventh rumb, that is, by the East and by North, or East and by South, or by the West and by North, or West and by South: or else by the East Northeast, or VVest Southwest; or by the East Southeast, or West Northwest, there is a certain difficulty which may breed great errour in finding the traverse point, notwithstanding the latitude be taken; by reason of the Rudder that guideth the ship, which giveth certain yawes out of the course that the Pilot pretendeth, or by reason of the winde which bloweth not right in the poop, but maketh the ship fall to the leeward, from the direct and true course which it ought to keep. Wherefore because in such a case, if you find your point by traversing, suppose by East and by North, the way which I think is made, and hath been sailed may be by the East Northeast: which point so found, must stand more forward then the true point, by so much difference as there is between 42 and 88 Spanish leagues, which is 46 leagues, that is, the difference of distance from the Meridian, or North and South line in those two points. In such a case as this, it is not meet to find your point by traversing, to avoid the errour which hereupon may insue, which errour ariseth of such a cause, as that a mans judgement, be it never so good, cannot easily determine thereupon, and so consequently he cannot judge precisely. But to avoid confusion and cause of errour, he must cast his point in manner following, and he shall erre as little as is possible.

Let him examine according to the ordinary running of his ship, how much way she might make every day that he hath sailed; and the leagues that shall amount in all the dayes, let him take between the points of one compass: and let him place

one

one point thereof upon the place from whence he departed: and taking another compaſs, let him ſet one point thereof upon the graduation, according to the heighth which he hath taken, and the other point upon the next East and West Rumb. Now let this compaſs run by his East and West rumb, till the point coming from the graduation meet with the ſecond point of the other Compaſs which he holdeth not upon the Chart: and in the place where they meet, he may ſay that there is his point and his ſhip.

And becauſe in this caſe all Pilots do not uſe this point of imagination and heighth, there grow great diverſities among them concerning their diſtance from land, when as in long voyages they confer and communicate their opinions one with another; inſomuch that one according to his conjecture judgeth himſelf to be 50 leagues from land, another 100, another 200, and another thinketh he is hard by the land. The reaſon is, becauſe ſome of them caſt their point by traverſing, others by imagination onely, and others by imagination and heighth, who are alwayes more certain then the reſt.

CHAP. XXIV.

What it is to increaſe or diminiſh in heighth.

THe Mariners call it increaſing in heighth, when they go further and further from the Equinoctial; and diminiſhing in height when they approach neerer to the Equinoctial. So that in our Navigation we either ſail from a greater to a leſs altitude of the pole, and then we go towards the Equinoctial, and then the height is ſaid to be diminiſhed: or we ſail from a leſs to a greater height of the pole, and then we go from the Equinoctial, and are ſaid to increaſe our heighth. And hence it is, that caſting our point by imagination, and afterwards (having taken the heigth) amending it by traverſing; either the heighth, wherein we find our ſelves being taken by the Sun or ſtar is greater, or elſe it is leſs then that which we made account of by imagination. And hence do ariſe four rules: The firſt is, that when in ſailing we do increaſe the heighth, if the point amended by traverſing be of greater heighth then the point of imagination, the ſhip hath gone more then the point of imagination ſhewed us.

The ſecond, when we increaſe our heighth, if the point a-

mended by traverſing be in leſſe height then the point found by imagination, then hath the ſhip gone leſs way then we imagined.

The third is, when we diminiſh our height in ſailing, if the point amended by traverſing be in a greater heighth then the point found by imagination, then hath the ſhip made leſs way then we gheſſed by our imagination.

The fourth is, when we diminiſh our heighth, if the point amended by traverſe be in leſs heighth then the point found by imagination, then hath the ſhip made more way then we imagined.

Chap. XXV.

How you may caſt a traverſe point without Compaſſes.

IF a Mariner chance to loſe his Compaſſes, he may caſt his point of traverſe after this manner: Let him take two ſlender threds, and putting the end of one of them upon the place from whence he departed, let him ſtretch it in equal diſtance from the Rumb by which he hath ſailed, and putting another thred in equall diſtance from the next Eaſt and Weſt rumb, let him make it to paſs by the degrees of heighth, in which he findeth himſelf; and where the two threds croſs one another, there is the point of the ſhip: and alwayes the firſt thred (if it hath not changed the courſe) ſheweth the way which the ſhip hath gone, and the ſecond the parallel wherein the ſhip is.

Chap. XXVI.

Of another kind of caſting a point by traverſe.

EXamine the difference of the degrees of diſtance from the Equinoctial, which are between the place from whence the ſhip ſet forth, and the place where the ſhip is: Then taking the heighths of both places very preciſely, and ſubtracting the leſſer out of the greater, that which remaineth is the difference: which difference you muſt multiply by the leagues, which anſwer to one degree in the rumb by which you have ſailed, and thoſe leagues, which the degrees and minutes of difference ſhall make, you ſhall take between the points of a pair of compaſſes out of your ſcale of leagues: and holding the ſaid compaſs ſo open, ſet one foot thereof upon the point from whence the ſhip departed

departed, and the other foot ſtretching towards the place whithre the ſhip hath ſailed, you muſt hold up a little from the Chart: and you muſt ſet one foot of the other Compaſſe at the degree of the diſtance wherein your ſhip is from the Equinoctial, when the ſaid point is ſought for, and the other point you muſt place upon the next Eaſt and Weſt Parallel. And let this ſecond Compaſſe run by his next Eaſt and Weſt Rumb, untill the point of the firſt Compaſſe lifted up, being ſet downe, that point of the ſecond Compaſſe which came from the ſaid degree doth meete therewithal: and where thoſe two points ſhall meet, there is the true point of the ſhip.

CHAP. XXVII.

Of the leagues which in Navigation anſwer to each degree of Latitude in every Rumb.

IF we ſuppoſe (as we have before ſaid in the chap. (*of the quantity of the earth*) that the greateſt circle thereof conaineth in compaſſe 6300 common Spaniſh leagues; then unto every degree of the Meridian (which is the greateſt circle) doe anſwer 17 Spaniſh leagus and an half: ſo that ſailing North and South, if your heighth of the Pole, or your diſtance from the Equinoctial be varied one degree, you may ſay that you have gone ſeventeen leagues and an half: but if you varie one degree, and hold your courſe upon the firſt point, then have you ſailed 17 leagues and $\frac{1}{6}$: And you have declined from the Meridian or right line which paſſeth by the place from which you departed, three leagus and an half. And if you ſail upon the ſecond point from the North or South till your heighth of the Pole be changed one degree, you have then gone 19 leagues and $\frac{3}{8}$, and are diſtant from your right line 7 leagues and $\frac{1}{4}$: And varying a degree upon the third point of the Compaſſe from North or South, you have gone 21 leagues, and are departed from your right line 11 leagues and $\frac{1}{3}$.

Sailing upon the fourth point of the Compaſſe, there doe anſwer unto every degree 24 leagues and three fourths, and you are diſtant from the right line or Meridian 17 leagues and an half. Upon the fifth point you muſt allow for one degree 31 leagues and an half, and then are you diſtant from your right line 26 leagues and $\frac{1}{5}$. Upon the ſixth point doe anſwer unto one degree of Latitude 45 leagues and $\frac{3}{4}$, and you are then parted from

from your right line 42 leagues and $\frac{1}{4}$. Upon the seventh point doe answer unto one degree of Latitude 89 leagues and $\frac{3}{4}$, and you are departed from your right line 88 leagues, as it appeareth out of the Table following,

The Table of the Author which is more precise.

Leagues of the course or Rumb.		Distance from the right line	
1	17 $\frac{5}{6}$	3	$\frac{1}{2}$
2	19 $\frac{3}{8}$	7	$\frac{1}{4}$
3	21	11	$\frac{2}{3}$
4	24 $\frac{3}{4}$	17	$\frac{1}{2}$
5	31 $\frac{1}{2}$	26	$\frac{1}{5}$
6	45 $\frac{3}{4}$	42	$\frac{1}{4}$
7	89 $\frac{3}{4}$	88	

The old Table which is less certaine.

Leagus of the course or Rumb.	Distance from the right line or Meridian.
18	3 $\frac{1}{2}$
18 $\frac{1}{2}$	7 $\frac{1}{2}$
21 $\frac{1}{2}$	11 $\frac{2}{3}$
25	17 $\frac{1}{2}$
31 $\frac{1}{2}$	26 $\frac{1}{2}$
46 $\frac{1}{2}$	42 $\frac{1}{2}$
88	85

Chap. XXVIII.

How you may come to know the Longitude or the course from East to West.

That which the Cosmographers call Longitude, is called by the Mariners the distance from the right line, and the course of East and West, and the heighth of East and West, and it is a part of an East and west Rumb contained between two Meridians, one of which runneth by the point or place from whence we departed, and the other by the point where the ship is. This distance from the right line is known by the mean of two things, namely of the course and of the difference of Latitude, or of the course and distance.

The course and the difference of the heighth being given, you may know the said distance by traverse or by numbers. By Geometry, or traverse it is known in manner following: the heighth, or the distance of your ship from the Equinoctial being known, and the Rumb also upon which you have sailed, you must cast upon your chart a point by traverse, and placing upon that point one of the points of your Compasses, and the other upon the next Rumb of East and West; you must place one point of another paire of Compasses at the haven or point from whence the ship

ſhip departed, and the other point upon the North and South Rumb which is next. Theſe two Compaſſes thus opened, running by their Rumbs one towards another, you muſt mark where the two points meet; namely, that which came out of the part from whence you departed, and that which you removed from the point where the ſhip preſently is, being found by traverſe: and where thoſe two points doe meet, there make another point or prick. Then looke how many leagues there are from the ſaid third point to the point of traverſe where the ſhip is, (both which doe alwaies beare Eaſt and Weſt one from another) ſo many leagues is your diſtance from the right line. And if in ſtead of the leagues ſet down in the ſcale wee meaſure with degrees taken out of the graduation, *we ſhall have the degrees of Longitude which are between the point of our departure, and the point of the place where preſently we are.*

This for the moſt part is not true in the ordinary Sea-chart.

And it is to be noted, that alwayes when we ſail, we either alter our latitude onely, and that is, when we ſail North and South, or we alter the longitude onely, that is, when we ſail by the ſelf-ſame latitude, going alwayes Eaſt and Weſt by the ſame parrallel: or we alter both latitude and longitude, when we ſail by any of the other 28 winds. When we alter the latitude only we ſwerve not one jot from the right line or Meridian; when we alter both longitude and latitude, then muſt we find the longitude or diſtance from the right line in manner above-ſaid.

But when your longitude onely is altered, becauſe then you muſt find out the point where the ſhip is by imagination onely, there is no certain manner to know the longitude or diſtance from the right line, but onely little more or leſſe, ſetting down a point by imagination, and meaſuring by leagues, or by degrees, what diſtance there is between that and the point from which the ſhip departed. By numbers you may find out the longitude in manner following: The difference of your diſtance from the Equinoctial being known, which is ſo many degrees more or leſs, as you have increaſed or diminiſhed in the heighth of the Pole, look in the Table annexed to the chapter next before this, for the leagues of diſtance from the right line, which anſwer unto one degree by the rumb or point of the compaſs upon which you have ſailed; and multiplying thoſe leagues by the number of degrees which you have increaſed or diminiſhed in the heighth of the pole in your Navigation, you ſhall then ſee how many leagues you are diſtant from the right line, which paſſeth by the place from whence you came, which leagues if you

divide by 17 and an half, then will appear unto you the degrees of longitude between the place from whence you departed, and the point where you are.

CHAP. XXIX.

How you may ſet down in your Chart a new Land, never before diſcovered.

IT may ſometimes fall out in new Diſcoveries, or when your ſhip by means of a tempeſt is driven out of her right courſe, that you ſhall come to the ſight of ſome Iſle, Shoald, or new Land, whereof the Mariner is utterly ignorant. And to make ſome relation of the ſame, or to go unto it ſome other time, if you deſire to ſet it down in your Sea-chart, in the true place, you may do it after this manner: So ſoon as you have ſight thereof, mark it well firſt with your compaſs, obſerving diligently upon which point thereof it lieth. And ſecondly, you muſt there take the heighth of the Sun, or of the Pole-ſtar, that you may know in what point your ſhip is, and that point you muſt call the firſt point; which being ſo done, your ſhip may ſail on her courſe all that day, till the day following, without loſing her way: and the next day mark the land again, and ſee upon what point it lieth, and then take your heighth, and with it caſt your point of traverſe once again; and that you may call your ſecond point. Then take a pair of compaſſes, and placing one foot upon the firſt point, and the other upon the rumb towards which the land did bear, when you caſt your firſt point: ſet alſo one foot of another pair of compaſſes in the ſecond point, and the other foot upon the rumb upon which the land lay when you caſt your ſecond point; and theſe two compaſſes thus opened, you muſt move by their rumbs, till thoſe two feet of both compaſſes do meet together, which were moved from the foreſaid two points: and where they do ſo meet together, there may you ſay is the land which you diſcovered; which land you may point out with the in-lets and out-lets, or capes and other ſignes, which you ſaw thereupon. And by the graduation you may ſee the latitude thereof, that thereby you may finde it, if at any time after you go to ſeek for it.

CHAP. XXX.

Seeing two known points or Capes of land as you ſail along, how you may know the diſtance of your ſhip from them.

IT is the cuſtome of paſſengers, when they firſt deſcrie that land which they would arrive at, to ask the Pilot, how far they are from land. Unto which queſtion he may well anſwer, if he know two capes, or points, or notable places thereupon: which places the further they be aſunder one from another, the more certainly may he anſwer to that queſtion.

Let him pitch therefore one foot of one pair of compaſſes upon one of the two foreſaid capes, and the other foot upon the rumb which in his compaſſe pointeth towards that cape. And in like manner ſhall he do with another pair of compaſſes, placing one foot thereof upon the other known cape, and the other foot upon the rumb, which ſtretcheth towards the ſaid ſecond cape; and moving the two Compaſſes ſo opened by their two Rumbs off from the land, the very ſame point where the two feet which came from the two capes do meet, you may affirm to be the very point where your ſhip is. And then taking meaſure by the ſcale of leagues, you may ſee what diſtance there is from the ſaid point to either of the foreſaid capes, or to any other place, which you think good, for it is a very eaſie matter if you know the point where your ſhip is.

CHAP. XXXI.

Of the account of the Moone.

THe account of the Moone and of the tides is moſt neceſſarie to be known of Mariners, to enter and depart from any Havens, Rivers, or Barres, and to paſs by ſome banks, and ſhoalds.

A tide is a regular motion of the Sea whereby at ſome times it ſeemeth more increaſed then at other. And theſe tides are of two ſorts: for ſome are ſuch as we call ſpring-tides and neap-tides, and the courſe of this motion hapneth from one half moneth to another half moneth. Others be thoſe which we call more

properly by the names of tides; to wit, a full ſea, and a low ſea, a ſwelling and a falling ſea: and theſe are from the one half lunar day, to the other half. Which tides, as well the firſt as the ſecond, have their courſe and moving from the motion of the Moone: which is of two ſorts; one proper from Weſt to Eaſt, by means whereof in thirty days almoſt, it is in conjunction with the Sun, which we call the new Moone; and in oppoſition, which wee call the full of the Moone; and thoſe wee name the quarters, when it ſhineth half unto us. The other motion is from Eaſt to Weſt by the force of the *Primum mobile*, or the firſt moveable heaven, whereby in one lunar day the Moone paſſeth over all the two and thirty points of the compaſſe, or to ſpeak more plainly, it riſeth and ſetteth, and returneth again to ariſe. which two motions of the Moone being known, we may eaſily diſcerne the manner of both kinds of the foreſaid tides. And becauſe that to the knowledge hereof it is requiſite that we know the middle motion of the Moone; I will firſt ſet down how it may be known, and then how thereby wee may diſcerne the ſeaſons of the tides.

For which purpoſe, we are to note that the golden number, as it is commonly called, is a certain number of years wherein the Moone hath all the diverſities of aſpects with the Sun that can happen between them, which is done in every nineteen years almoſt.

As for example, if in the year 1588 there be a conjunction of the Sun and Moone upon the 26 of *April*, or an oppoſition upon the 11 of *April*, I ſay that there ſhall not happen a conjunction of the Sun and Moone upon the 26 of *April*, nor an oppoſition upon the 11 of *April*, till 19 years be expired, which will be in the year of our Lord 1607. And ſo are wee to conceive likewiſe of the quarters and other aſpects.

The ſecond thing to be noted, is, that from this golden number ſpringeth another, which is called the concurrent being the days of the Moone at the beginning of the year: which year, according to that account, beginneth from the laſt of *February*, about twelve a clock at night, which is the beginning of *March*. And the days of the Moone which then remain, beſides all the whole lunare moneths of the year paſt, are called by Calculators *The concurrents*; becauſe they ſerve to know the account of the Moone, throughout the whole year that is to come; and they concur with other numbers to know the age of the Moone. Now by theſe two numbers, to be able to diſcern the days of the

Moone

Moone, or the distance thereof from the Sun, you are to note the Rules following.

The first Rule of the Golden number.

From the present year of our Lord you must deduct 1500. and out of the remainder, taking one in every twenty, we shall finde the golden number, if they be just twenties. But if they be not just twenties; above the number of twenties wee must add that which remaineth above the twenties: all which being added together, if it exceed not nineteene, shall be the golden number. But if it exceed nineteen, cast away nineteen, and the remainder is the golden number.

The second Rule of the concurrent.

Divide the golden number by three, and if there remaine one, the concurrent is equall with the golden number; and if there remaine two, the concurrent is greater then the golden number by ten: but if nothing remaine, the concurrent exceedeth the golden number by twenty. And if this concurrent exceed the number of thirty, then the remainder or surplussage shall be the concurent.

The third Rule of the Conjunction.

The number of the concurent being known, you must add it unto the number of moneths, which have passed from the beginning of *March* last past, till the end of that moneth wherein you would know the same: and if the whole product amounteth not to thirty, mark how much it wanteth of thirty: and if it exceedeth thirty, see what it lacketh of sixty, and that which it wanteth either of thirty or sixty is the number of the days of such a moneth wherein the Conjunction hapneth.

The fourth Rule of the full and quarters of the Moone.

If the day of the Conjunction be before the 15 day of the moneth, add 15 unto the day of the Conjunction, and you shall find the day of the full Moone; and if the Conjunction happen after the 15 day, take away 15 from the number of the day of the Conjunction, and you shall have the full Moone of that moneth.

The first quarter is seven daies after the Conjunction, and the last quarter seven days after the full Moone.

The fifth Rule of the Spring-tides and Neap-tides.

Upon the day of the Conjunction, and of the full Moone, are the Spring-tides. and upon the two quarter days are the Neap-tides: and so much the more doe the waters increase, as the Conjunction or full Moon are nerer: and so much the more they decrease also the neerer they come unto the quarters.

An example whereby the foresaid Rules are made more plain.

Suppose a fleet of Ships lie within the heaven of *San Lucar de barrameda*, expecting a fit time to passe over the barre towards the Indies. It is evident that if the Ships be great, they have need of much water to pass the bank, or the barre: which quantity of water is only in the Spring-tides. And because they are twice in one moneth, namely in the Conjunction, and in the full of the Moon, I desire to know when the Spring-tides and Neap-tides of the moneth of Iune in the year 1588 were to be expected, in which moneth I presuppose the fleet was to depart. First therefore I cast away 1500. and out of the 88 remaining I take from each 20. One, which make four in all; which being added to the 8 that surmount 80. they make the golden number to be 12, according to the first Rule. I divide these twelve by three, and the quotient is foure, and nothing remaineth and because there is no remainder, I will take two more of the concurrent then of the golden number, and there shall be two of the concurrent, casting away thirty; by the second Rule. Adding these two to the four moneths which are from the beginning of *March* past till this present moneth of *Iune*, I find that they make six. And because six want twenty four to make up thirty, I say that in the year 1588, we had a Conjunction of the Moon upon the 24 of *Iune*, by the third Rule, and adding seven unto the day of this Conjunction, you have the first day of *July*, which is the day of the first quarter. And taking away 15 from 24 being the number of the Conjunction day, there remain nine, and upon that day of the moneth you have the full Moon. And adding other seven unto the nine days of the full Moon, you have the last quarter upon the sixteenth of *Iune* by the fourth Rule.

These days mentioned in this example, are to be understood according to the new Roman Gregorian Kalender, which goeth always ten days before ours used in England.

Rule. I ſay therefore that the Spring-tides or greateſt waters of the moneth of *Iune*, were in that year upon the ninth, and four and twentieth days of *Iune*; and the Neap-tides, or leſs waters were upon the ſixteenth day of *Iune*, and the firſt of *Iuly* by the fifth Rule.

CHAP. XXXII.

Of the daily Tides.

NOW that we know the Rules of the Spring-tides and neap-tides, let us ſay ſomewhat of the Tides that happen every day, which depend upon another ſwift motion of the Moon, whereby turning round about the world from Eaſt to Weſt, it paſſeth every day by the 32 points of the Compaſſe: and this dayly motion of the Sea, falleth not every day at the ſame hour, becauſe the Moon doth not alwaies keep one and the ſame diſtance from the Sun. For the Moon moveth almoſt thirteene degrees of her proper motion in one natural day, whereas the Sun moveth ſcarce one: and ſo one being taken from thirteene, there remain 12. And becauſe the Sun doth give, and marke out unto us hours, and the Moon Tides, it commeth to paſs that an hour being that ſpace of time wherein fifteene degrees of the Equinoctial paſs by every point of the Compaſſe, the part by which the Moon is diſtant from the Sun ſhall be twelve degrees, which twelve are $\frac{4}{5}$ of fifteene degrees contained in each hour. Inſomuch that the Moon by her middle motion is every day diſtant from the Sun about twelve degrees; which being reduced into time, do make $\frac{4}{5}$ parts of an hour, whereby the Moon is every day ſlower then the Sun, in comming to each point of the Heavens by the motion from Eaſt to Weſt, in regard of that which ſhe hath borrowed for her own proper motion from Weſt to Eaſt. Whereof it commeth to paſſe, that ſo many days as the Moon is old ſo many times $\frac{4}{5}$ parts of an hour it is ſlower then the Sun in paſſing by each Rumb, untill the day of their conjunction, when as they paſſe both by the ſame Rumb, in one and the ſame hour. And ſo accordingly, becauſe we are to ſet down the certain hour of every day wherein the Tide happeneth, we muſt diligently Obſerve the Rules following.

The

The first Rule.

In divers parts of the Sea coast, the Moon maketh a full Sea every day, being in divers Rumbs, according to the disposition of the Land. But upon all the coast of Spain in the Ocean, it is full Sea when the Moon is in the North-east and South-west.

The second Rule.

Upon the day of the conjunction and full Moon, you have a full Sea at three a clock in the morning, and at three in the after noon; for at those hours the Moon goeth with the Sun at the North-East and at the South-west. But upon other daies of the Moon, the full Sea falleth out at the same hour when the Moon commeth to those two points; which is known by counting the age of the Moon.

The third Rule.

That you may know at all times how many daies old the Moon is, you must add three numbers together; to wit, the concurrent, and the moneths from the beginning of *March* to the moneth present, and the daies of the moneth wherein you would know this: and if the whole product exceedeth not thirtie, it containeth just the daies of the Moon; but if it doth exceed thirtie, the surplussage sheweth the daies of the Moons age.

The fourth Rule.

Multiplie the daies of the Moons age by four, and divide the product by five, and the remainder after division containeth the hours whereby the Moon commeth more slowly then the Sun, to the North-east or South-west, or to that Rumb wherein it maketh a full Sea; which hours shall be added to the three hours of the morning, and then you have the hours of the first Tide or of the full and swelling Sea; and six hours and almost a quarter after, commeth the first ebbe, or low water, and 12 hours and $\frac{1}{5}$ after the first full Sea, commeth the second Tide: and other six hours and $\frac{1}{5}$ after the second Tide, commeth the second ebbe.

The fifth Rule.

When the daies of the Moons age are leſs then fifteene, we may make by them our account for the Tides: but if they exceed fifteene, we muſt make our account by the ſurpluſſage.

An example of the ſaid Rules.

Upon the 29 of *July* 1588, I deſired to know the hours of the full Sea and of the ebbe; to make choice of that which might ſeem moſt expedient for my Voyage. By the former example I find that the golden number of this year is 12 and the concurrent 2, according to the correction of the year by Pope *Gregorie* the 13. Then I add this number of 2 to the number of 5 moneths, which have paſſed from the beginning of *March*, and the 29 days of the moneth of *July*, all which 3 numbers make 36; then I caſt away 30, and there remain ſix daies for the age of the Moon: and becauſe they exceed not fifteene, I multiply them by $\frac{4}{5}$ of an hour, according to the fourth Rule, and they make $\frac{24}{5}$ I divide theſe 24 by 5, and I find the quotient to be four, and the remainder four. And ſo I ſay that the Moon commeth to the North-eaſt four hours and $\frac{4}{5}$ later then the Sun. And becauſe the Sun commeth to the North-eaſt at three a clock in the morning, I add thoſe 4 hours and $\frac{4}{5}$ unto the 3 hours laſt mentioned, and they make ſeven hours and $\frac{4}{5}$, which is the hour of the morning wherein the Tide or full Sea happeneth. And adding unto theſe ſeven hours and $\frac{4}{5}$ other ſix hours and $\frac{1}{5}$, they make in all fourteene hours, which falleth out at two a clock in the afternoon, which is the hour of the firſt low water or ebb. And adding unto the ſaid hour of the full Sea twelve hours and $\frac{2}{5}$, it will amount unto eight of the clock and $\frac{1}{5}$ part of an hour, which is the hour of the night wherein the ſecond Tide or high water was. And add unto this ſecond Tide other ſix hours and $\frac{1}{5}$, and they make two of the clock in the morning and $\frac{1}{5}$, at which time there commeth the ſecond ebb or low Sea.

Chap. XXXIII.

Of a certain Instrument, whereby you may in generall judge of the Tides.

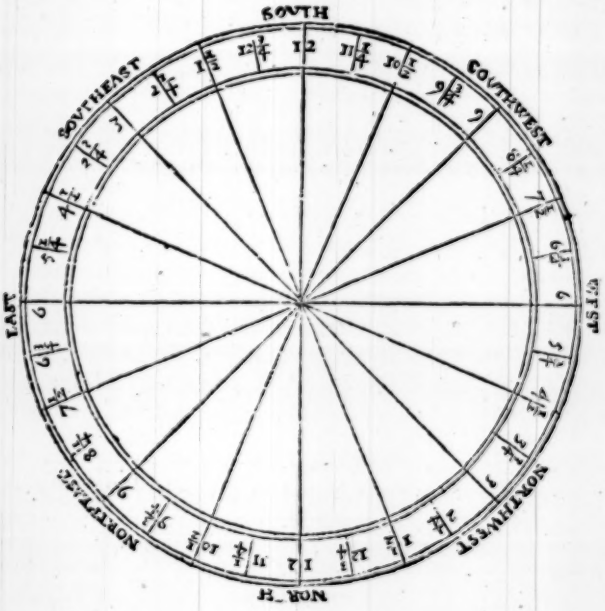
BEcause the Tides (it being supposed that in all places they proceed from the motion of the Moon) run not in every part of the world by one and the same Rumb, as it is manifest in the channell of *Flanders*, and in all the coasts of the Northern Sea, which is a matter of great confusion and difficulty to Mariners; I thought good here to set down an Instrument, whereby (the daies of the Moon and the Rumb, whereupon the Moon causeth the Tide in every part, being known) they may judge of the ebb and flood with great facility.

Draw upon a sheet of paper, or upon a plate of tinn, or any other matter, a circle as bigg as the palm of a mans hand, and half a fingers bredth; within that circle draw another circle; and having divided them both into 32 equall parts, with lines drawn from the center to the circumference of the greater circle, upon the upper end of one of those lines, place a flower-deluis, and the number of 12, and in the next line thereunto toward the left hand, set down 12 and $\frac{3}{4}$, and in the third line 1 $\frac{1}{2}$, and so proceed forwards, putting down upon every line following $\frac{3}{4}$ of an hour more, untill you come again to the number of 12 in the lowest line. And from thence forwards set down the same numbers that you did at the first.

These 32 lines so drawn, doe represent the 32 winds, whereby the Sun and Moon pass every day. And so you may set down the names of the principal Winds, to the end that you may know them, and those that are next them. And then in like manner make another round and slender Table, as bigg as the innermost circle of those two which you drew in the first Table: and dividing it into thirty equal parts, first into two by a line, dividing it in the midst, and then either of those two into three, and every of those three into five: these divisions will represent the days of the Moon. And leaving upon 1 of those parts an Index or small point, which may reach without the circle, set down the numbers thereof, beginning with 30 in that part where that point endeth, and the number of 1 in the line following towards the left hand, and then 2, &c. till you end at the same point with 30, This being done, fasten with a thred or nail, the

second

ſecond Table or Circle upon the center of the firſt, ſo that it may freely without impediment turne round about.



The uſe of this Inſtrument.

The uſe of this Inſtrument is, that knowing in every Port or part of any coaſt, the Rumb or quarter on which the Moon maketh full Sea, or high water, you muſt note upon the outward Circle of the Winds that quarter or Rumb: and placing the tooth or point of the inner Circle were the number of 30 is upon that quarter or Rumb; make it there faſt, puting a litle wax underneath, that it may not move. Then account the days of the Moons age in the inner Circle, and over againſt the end of your account you ſhall ſee in the uttermoſt Circle the hour of the full Sea of that day, together with the Rumb where the Sun is at that hour. And at the ſame hour when it is in the contrary part, it will make a full Sea. The place of the moon at the hour of the tide, is alwaies either where the point is, or at the point right

over against it, and hence you may easily find both ebbes also. This little Instrument, although it be but of small Invention, is of great use and profit for the Navigations of *Flanders*, *France*, *England*, *Ireland*, and all the Northern regions, where you have much variety in the tides.

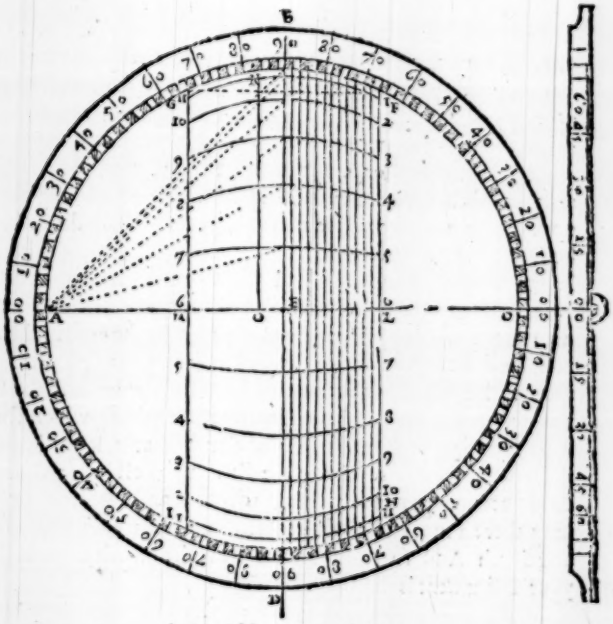
CHAP. XXXIIII.

Of the making of an universall Diall, which may serve Generally all the World over.

DRaw upon a Table or pastboord the Circle A B C D upon the center E: and half a fingers breadth within that Circle, upon the same center draw another Circle: and about the breadth of a wheat corn within the second Circle, draw a third; and placing your Ruler upon the center E, by the right line A C divide the two inner Circles in the midst A B C, and C D A in the points B D, upon which, and upon the center E the Ruler being placed, you may draw the line B D, whereby every one of the foresaid Circles shall be divided into four equal parts. And dividing every one of those four Quadrants of the inner Circle, to wit, A B, B C, C D, D A into 90 parts (as the manner is in the making of an Astrolabe) set numbers thereto from 5 to 5. begining your account from the two points A C, and so proceding both ways till you end your account in 90, at the points B D; and this inner Circle thus divided, representeth the Meridian.

And the point C is the North, A the South, and the points B D are those where the Equinoctial cutteth the Meridian. Then count 23 degres and an half from the point B to F, and to G on both sides. And so much account also from the point D to H and to I. And then drawing two right lines F H and G I, the line F H shall represent the Tropick of *Cancer*, and G I the Tropick of *Capricorn*. And those two lines shall cut the line C A, (which is the Axtree of the World, and the Circle of six of the clock in the morning and evening) upon the points L M. Then count fifteene degrees from C towards B, and other fifteeen from A towards B, and placing your Ruler on either side upon the end of your account, you shall cut the Equinoctial B D upon a certain point which shall represent unto you seven a clock in the morning, and five of the clock at evening. And counting other fifteen degrees on both sides, more towards the point B, and placing

cing the Ruler as before, you ſhall cut the line B D in another point, which ſhall repreſent eight of the clock in the morning, and four in the afternoon. And accounting higher fifteen degrees more one both ſides, and placing your Ruler upon the end of your account, it will divide the line B D at another point, which ſhall be nine a clock in the morning, and three in the afternoon; and ſo you ſhall proceed from fifteen to fifteen degrees, till you come to eleven of the clock in the morning, and one in the afternoon. And if you will have the half hours alſo, you muſt account from ſeven degrees and an half, to ſeven and an half; and doing as you did with the fifteenth degrees, you ſhall have the half hours alſo.



Then placing your compaſſes upon the center E, and upon every diviſion of the line E B you ſhall draw the ſame diviſions likewiſe upon the line E D which being done, draw certain obſcure lines from the point A to the diviſions of the line E B: and drawing the right line G F, ſee where G F is cut at the higheſt of the

obscure lines, which must be at the point N, from whence the line N O is to be drawn equally distant from the line B E. And this line N O shall be divided proportionally by the obscure lines, even as the line B E. Then let the divisions of the line N O be transferred into the lines M G, M I, L F, L H, and then the Tropicks also shall be divided. Then by every three points answerable in the Equinoctial, and the two Tropicks, you shall draw certain parts of Circles, seeking the center of those three points in the Equinoctial line extended forth on either side; and these parts of Circles represent the hours: then make an account of the degr. of Declination from the point B, and from D on both sides by every 2 degr. and draw lines Parallel to the Equinoctiall from one to another; and those shall be the Parallels of the Suns Declination. Moreover you shall make an Horizon as large as the Diameter of the inner Circle, which shall be divided after this manner: Count from the points A C towards B five degrees; and putting your Ruler upon the end of the account of both parts, see where it cutteth the line E B, and there make a mark: and then counting on both sides other five degrees, and putting the Ruler once again at the end of your account, make another mark where it cutteth the line E B. And so the line E B must be divided from five to five degrees; which divisions shall be removed into the said Horizon, fastning it to the Center, and laying it to the line B D, and dividing it both ways as the line E B is divided; and set numbers thereinto from 5 to 5, which may begin in the midst, and end with 90 at the ends of the Horizon, and let every one of these parts be divided into five other parts or degrees. Then accounting from the Center E in the Horizon eleven degrees and $\frac{1}{4}$, you shall set there a mark, which shall be the seventh point from North and South, that is, it shall represent the points which are next to the East and West in the Compasse. And accounting another eleven degrees and a quarter, and making there a mark, it shall represent the sixth point from North and South And so you must doe with the other points, and then your Instrument is finished.

CHAP. XXXV.

Of the parts of this Instrument.

IN this Instrument, the first thing is a Circle divided into 360 degrees, which is the Meridian and the line of twelve a clock.

The

The second are the right lines, of which that in the midst is the Equinoctial, and the two others are the Tropicks of *Cancer* and *Capricorn*. And the other lines between those are the Parallels of the Suns Declination, which have their numbers agreeable to them. And those that are between the Equinoctial, and the Tropick of *Cancer*, doe serve from the 11 of *March* to the 13 of *September*, and the others for the residue of the year. The crooked lines which cross those Parallels are the hour lines. And the point of the Meridian, which in 90 degrees distant from the Equinoctial, towards the left hand, is the North Pole: and the point opposite to that, is the South Pole. In the Horizon there are first the degrees, and then the points of the Compass distinguished by the small pricked lines.

CHAP. XXXVI.

How you may know what a clock it is by this Instrument.

AT any time of the day, when you would know what a clock it is, take the heighth of the Sun with your Astrolabe, and seeking the Table of the Suns Declination what Declination it hath the same day, and the height of the Pole; which a good Mariner knoweth at all times, because he must direct his course thereby. This being known, place the Horizon Instrument on the one side under the North, and on the other side above the South, so many degrees as his distance from the Equinoctial is the same day: and fasten it there with a little wax that it may not move. Then count in the Meridian on either side from the Horizon (which now standeth firm) the height of the Sun above the Horizon, take with your Astrolabe: and by the end of the account, draw a line or thred overthwart, which shall be equally distant from the Horizon. Then reckon the Suns Declination in the parallels, beginning from the Equinoctial of the Instrument that way which the Sun Declineth, and mark the line or Parallel at which the account of the Declination endeth; where and at what hour it is crossed by the thred, for that hour is the hour of the day. But note this, that if the crossing of the thred and Parallel doe fall upon the division of the Parallel and of the hour, it is a just hour; but if it fall beside the common meeting of the Parallel and of the hour-line upon that side where it falleth, see how much more there is then an hour, whether $\frac{1}{4}$, or $\frac{1}{3}$, or $\frac{1}{2}$, &c. Now although every hour line hath two numbers,

one

one of the morning and another of the afternoon, yet it is an easie matter to distinguish which of them will serve your turn, if you know whether your Observation be before high noon or after; which is to be known by your Astrolabe: for if the Sun ascend, it is before noon; but if it descend, it is afternoon.

CHAP. XXXVII.

Of the Variation of the Compasse, by this Instrument.

IF you would know by this Instrument the Variation of the Compasse, you must doe thus: When the Sun riseth or goeth down at the Horizon, Observe him with your Compasse, noting very diligently upon what Rumb and part of the Rumb he riseth or falleth. And if the compasse be divided into 360 parts, beginning to reckon them from the East and from the West on either side, and ending in the North and South with 90 degrees, it shall be the fitter for this purpose, because then you shall see the very degree of the Compasse upon which the Sun riseth or setteth. Then the Horizon being set fast (as we have shewed in the former chapter) mark in the Instrument by which part or degree of those upon the Horizon, the Parallel of the Suns Declination that day doth cross the same: counting in the numbers of the Horizon from the center towards the North Pole, if it be from the 11 of *March* to the 13 of *September*; or towards the South Pole, the other half of the year: And mark also whether this crossing be so many deg. distant from the division of the Equinoctial of your Instrument, as the Sun in his rising was distant from the East of the Compasse, or at his going down was distant from the West thereof; for then you may say that the Compasse hath no variation at all. But if it be not so, mark the Rules following.

1 When the Sun riseth by the same Rumb of the Compasse which the Instrument doth shew, the Compasse hath no variation at all.

2 When the Sun riseth more to the North of the Compasse, or goeth down more to the South, then is shewed by the Instrument, all the difference between the Instrument and the Compasse is the North-easting, or variation thereof to the East-ward.

3 If the Sun riseth more to the South of the Compasse, or setteth more to the North then the Instrument sheweth, all the difference between the Instrument and the Compasse is the North-westing, or Westerly variation thereof.

CHAP.

Chap. XXXVIII.

At what hour the Sun riſeth and ſetteth every day, in all parts of the world.

THE heighth of the Pole in that part where you deſire to know this, being known; place the Horizon in ſuch ſort as was ſhewed in the 36 chapter. And finding by the Table of the Suns Declinations the Declination which the Sun hath that day, count the ſame from the Equinoctial of the Inſtrument towards that part whither the Sun declineth among the Parallels, and then mark the Parallel whereat your account endeth, in what hour, and in what part of the hour it cutteth the Horizon; noting that every hour hath two numbers, one afternoon which is the hour of the Suns ſetting; and another before noon, which is that wherein the Sun riſeth.

Chap. XXXIX.

Of the length of the Day and of the Night.

THe hour of the Suns going down being known, double it and the double number of hours will ſhew you the length of the day. Alſo the hour of the Suns riſing being known, and doubled, will manifeſt unto you the length of the Night, in that part of the year when you deſire to know the ſame.

Chap. XL.

Of a Night-diall by the North.

THAT being known which is before declared of the ſituation of the North Star and of the guards, we may eaſily know in the night what a clock it is, whereſoever we can ſee the North Stars: preſuppoſing that upon the 15 of *April* at the very point of mid night, the former guard goeth a-head in reſpect of the North Star. And becauſe by this account of the hour of the night, we muſt take for a beginning, the very inſtant when the former guard maketh mid-night; the Rule following is to be Obſerved.

The Rule.

The number of the whole moneths which have passed since the 15 of *April* forward being double, you have the number of the hour wherein the former guard maketh midnight, being head-most: and if the moneths fall not out just, add for every fifteen days, above the whole moneths, one day, and for every day four minutes, and you shall know when it is midnight.

As for example.

If I would know upon the 15 of *November*, where the former Guard maketh midnight, I account the whole moneths from the 15 of *April*, and I find them to be seven: which being doubled, make fourteen. I say therefore, that upon the 15 of *November*, it shall be midnight, when the former Guard hath passed before the North or head fourteen hours. And so allowing three to the North-west, three to the West, and six to the foot, it may be said that the former Guard going two hours before the foot towards the South-west, that it is midnight, which shall come to passe when the former Guard goeth an hour before from the South-west. This being thus presupposed, when I would know in the night what a clock it is, I must note two things: the one is, in what part the former Guard maketh midnight the same night. The second is, in what part the said Guard is at the same instant, when I would know the time of the night; which being understood, I will make mine account from that which the Guard wanteth of being come to the place where that day it maketh midnight; or from so much as it hath passed the same place, making mine account that one third part of four points of the compasse is an hour, and that which it wanteth of being come, or which it hath passed forward, are the hours before midnight, if it be not come to the place; or after midnight, if it have gone beyond.

As for example.

I see the former Guard in the Northwest upon the 15 of *July*; because that upon the 15 of *July*, by the account before mentioned, the former Guard maketh midnight in the West: and from the North or head to the West, are six hours; and from the Northwest, where I saw the Guard, to the West, where it maketh midnight are three hours; I say therefore that it is three hours before midnight; that is to say, nine of the clock at night.

FINIS

BEcauſe the Tables of the Suns Declination that have bin moſt in uſe amongſt Engliſh Sea-men, doe both in faſhion and manner of uſing ſomething differ from thoſe before ſet down, pag. 173, 174, &c. Leaſt any therefore of the meanner ſort might be miſtaken, or ſhould not rightly conceive the manner of uſing theſe Tables; I thought good to adjoyn theſe alſo here following, bearing in a manner the ſame form and ſhape, and therefore alſo to be uſed altogether almoſt in the ſame ſort that thoſe Tables have been, which for theſe many years have been moſt uſed by Engliſh Mariners.

This Table of the Suns Declination containeth twelve particular Tables, ſhewing the Declinations of the Sun for every day of the twelve moneths of the year for four years together, from leap year to leap year. In the head of every one of theſe Tables is firſt ſet down the moneth for which that Table is made. Under this are placed the years of our Lord, for which thoſe Tables may ſerve: which years are divided into four ranks, ſignified by the four Arithmeticall characters 1, 2, 3, 4, that are ſet over them. The firſt rank containeth the firſt years immediately following after the leap year: the next rank containeth the ſecond years after the leap year: in the third rank are ſet down the years that follow three years after the leap year: and in the fourth and laſt rank are the fourth years after the precedent leap years, which are alſo leap years themſelves.

Under every one of theſe ranks of years there are two columns; the firſt whereof containeth the degrees and min. of the Suns Declination, anſwerable to every day of the moneth, ſuperſcribed in each of thoſe years, without ſenſible error. In the ſecond column are ſet down the minutes of the differences of the Suns Declinations for every one of thoſe dayes, for the readier finding of the part proportional of this difference, anſwering to any difference of Longitude from London, whereof you may read more pag. 181, &c. In the firſt column of each of theſe Tables next the left hand are placed the numbers of the days of the moneth that is ſet down in the head thereof. The uſe of this Table for knowing the Declination of the Sun at any time is thus: look the moneth and year wherein you would know the ſame in the head of the Table, and the day of the moneth in the firſt column next the left hand; then proceeding from that day directly in the ſame line towards the right hand till you come right under the ſame year, you ſhall there find the Declination you ſought for.

The uſe of this Table.

The Rule.

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The uſe of this Table.

Take for example the 24 day of *February* in the year 1610. Finding therefore that moneth and year in the head of the Table, and the 24 day in the first column; in the same line proceeding towards the right hand, till you come right under that year, you have there the Suns Declination for that time 5 degrees 34 minutes towards the South.

January

January

Day	1			2			3			4		
	1609 1613 1617			1610 1614 1618			1611 1615 1619			1612 1616 1620		
	deg.	mi.	di.	deg.	mi.	di.	deg.	mi.	di.	deg.	mi.	di.
1	21	47	10	21	50	10	21	52	10	21	54	9
2	21	37	10	21	40	10	21	42	10	21	45	10
3	21	27	10	21	30	11	21	32	10	21	35	11
4	21	17	11	21	19	11	21	22	11	21	24	11
5	21	6	12	21	8	11	21	11	11	21	13	11
6	20	54	12	20	57	12	21	0	12	21	2	11
7	20	42	12	20	45	12	20	48	12	20	51	12
8	20	30	13	20	33	13	20	36	13	20	39	13
9	20	17	13	20	20	13	20	23	13	20	26	13
10	20	4	14	20	7	13	20	10	13	20	13	13
11	19	50	14	19	54	14	19	57	14	20	0	13
12	19	36	14	19	40	14	19	43	14	19	47	14
13	19	22	14	19	26	14	19	29	14	19	33	15
14	19	8	15	19	11	15	19	15	15	19	18	14
15	18	53	15	18	56	15	19	0	15	19	4	15
16	18	38	15	18	41	15	18	45	15	18	49	16
17	18	22	16	18	26	16	18	30	16	18	33	15
18	18	6	16	18	10	16	18	14	16	18	18	16
19	17	50	17	17	54	17	17	58	17	18	2	17
20	17	33	17	17	37	16	17	41	16	17	45	16
21	17	16	17	17	21	17	17	25	17	17	29	17
22	16	59	17	17	4	18	17	8	18	17	12	17
23	16	42	18	16	46	17	16	50	17	16	55	18
24	16	24	18	16	29	18	16	33	18	16	37	18
25	16	6	18	16	11	19	16	15	18	16	19	18
26	15	48	19	15	52	18	15	57	19	16	1	18
27	15	29	19	15	34	19	15	38	18	15	43	19
28	15	10	19	15	15	19	15	20	19	15	24	19
29	14	51	19	14	56	19	15	1	20	15	5	19
30	14	32	19	14	37	20	14	41	19	14	46	19
31	14	13		14	17		14	22		14	27	

South Declination.

South Declination.

February

Day	1			2			3			4		
	1609 1613 1617			1610 1614 1618			1611 1615 1619			1612 1616 1620		
	deg.	mi.	di.	deg.	mi.	di.	deg.	mi.	di.	deg.	mi.	di.
1	13	53	20	13	58	20	14	2	20	14	7	20
2	13	33	21	13	38	21	13	42	20	13	47	20
3	13	12	20	13	17	20	13	22	20	13	27	21
4	12	52	21	12	57	21	13	2	21	13	6	20
5	12	31	21	12	36	20	12	41	20	12	46	20
6	12	10	21	12	16	21	12	21	21	12	26	21
7	11	49	21	11	55	22	12	0	22	12	5	21
8	11	28	21	11	33	21	11	38	21	11	44	22
9	11	7	22	11	12	22	11	17	21	11	22	21
10	10	45	22	10	50	22	10	56	22	11	1	22
11	10	23	22	10	28	21	10	34	22	10	39	22
12	10	1	22	10	7	22	10	12	22	10	17	22
13	9	39	22	9	45	22	9	50	22	9	55	22
14	9	17	22	9	23	23	9	28	22	9	33	22
15	8	55	23	9	0	22	9	6	23	9	11	22
16	8	32	22	8	38	23	8	43	22	8	49	22
17	8	10	23	8	15	22	8	21	23	8	26	23
18	7	47	23	7	53	23	7	58	23	8	4	22
19	7	24	23	7	30	23	7	35	23	7	41	23
20	7	1	23	7	7	23	7	12	23	7	18	23
21	6	38	23	6	44	23	6	49	23	6	55	23
22	6	15	23	6	21	23	6	26	23	6	32	23
23	5	52	23	5	58	24	6	3	23	6	9	23
24	5	29	24	5	34	23	5	40	23	5	46	23
25	5	5	23	5	11	23	5	17	24	5	22	24
26	4	42	24	4	48	24	4	53	23	4	59	23
27	4	18	23	4	24	23	4	30	24	4	36	23
28	3	55		4	1		4	6		4	12	24
29										3	49	23

South Declination.

South Declination.

North Declination.

March

Day.	1			2			3			4		
	1609 1613 1617			1610 1614 1618			1611 1615 1619			1612 1616 1620		
	degr.	mi.	di	Deg.	M	di.	De.	mi.	di.	Deg.	M	di
1	3	31	1	3	37	24	3	43	24	3	23	24
2	3	8	23	3	13	23	3	19	23	3	1	24
3	2	44	24	2	50	24	2	56	24	2	37	23
4	2	20	24	2	26	24	2	32	24	2	14	24
5	1	57	23	2	3	23	2	8	24	1	50	24
6	1	33	24	1	39	24	1	45	23	1	27	23
7	1	9	24	1	15	24	1	21	24	1	3	24
8	0	46	23	0	51	24	0	57	24	0	39	24
9	0	22	24	0	28	23	0	33	24	0	15	23
10	0	2	24	0	4	24	0	10	23	0	8	24
11	0	25	23	0	20	24	0	14	24	0	32	24
12	0	49	24	0	43	23	0	38	24	0	56	23
13	1	13	24	1	7	24	1	1	23	1	19	24
14	1	36	23	1	31	24	1	25	24	1	43	23
15	2	0	24	1	54	23	1	49	24	2	6	24
16	2	24	23	2	18	24	2	12	23	2	30	23
17	2	47	23	2	41	23	2	36	24	2	53	24
18	3	10	24	3	5	24	2	59	23	3	17	23
19	3	34	23	3	28	23	3	22	23	3	40	23
20	3	57	23	3	51	24	3	46	24	4	3	24
21	4	20	23	4	15	23	4	9	23	4	27	23
22	4	43	23	4	38	23	4	32	23	4	50	23
23	5	6	23	5	1	23	4	55	23	5	13	23
24	5	29	23	5	24	23	5	18	23	5	36	23
25	5	52	23	5	47	23	5	41	23	5	59	22
26	6	15	23	6	10	22	6	4	23	6	21	23
27	6	38	22	6	32	23	6	27	22	6	44	22
28	7	0	23	6	55	22	6	49	23	7	6	23
29	7	23	22	7	17	23	7	12	22	7	29	22
30	7	45	22	7	40	22	7	34	22	7	51	22
31	8	7		8	2		7	56		8	13	

South Declination. Equinoctial North Declination.

South Declination. North Declination.

April.

North Declination.

Dgs.	1			2			3			4		
	1609 1613 1617			1610 1614 1618			1611 1615 1619			1612 1616 1620		
	degr.	mi.	di	deg.	mi.	d.	deg.	mi.	di	deg.	mi.	di
1	8	29	22	8	24	22	8	18	22	8	35	22
2	8	51	22	8	46	22	8	40	22	8	57	22
3	9	13	21	9	8	21	9	2	22	9	19	21
4	9	34	22	9	29	22	9	24	22	9	40	22
5	9	56	21	9	51	21	9	46	21	10	2	21
6	10	17	21	10	12	21	10	7	21	10	23	21
7	10	38	21	10	33	21	10	28	21	10	44	21
8	10	59	21	10	54	21	10	49	21	11	5	21
9	11	20	21	11	15	21	11	10	21	11	26	21
10	11	41	20	11	36	20	11	31	20	11	46	20
11	12	1	20	11	56	20	11	51	20	12	6	20
12	12	21	20	12	16	20	12	11	20	12	26	20
13	12	41	20	12	36	20	12	31	20	12	46	20
14	13	1	19	12	56	20	12	51	20	13	6	20
15	13	20	20	13	16	19	13	10	19	13	26	19
16	13	40	19	13	35	19	13	30	20	13	45	19
17	13	59	19	13	54	19	13	50	20	14	4	19
18	14	18	18	14	13	19	14	9	19	14	23	18
19	14	36	19	14	32	18	14	27	18	14	41	19
20	14	55	18	14	50	19	14	46	19	15	0	18
21	15	13	18	15	9	18	15	4	18	15	18	18
22	15	31	18	15	27	17	15	22	18	15	36	17
23	15	49	17	15	44	18	15	40	18	15	53	18
24	16	6	17	16	2	17	15	58	17	16	11	17
25	16	23	17	16	19	17	16	15	17	16	28	17
26	16	40	17	16	36	17	16	32	17	16	45	17
27	16	57	16	16	53	16	16	49	16	17	1	16
28	17	13	16	17	9	16	17	5	16	17	17	16
29	17	29	16	17	25	16	17	21	16	17	33	16
30	17	45		17	41		17	37		17	49	

North Declination.

May.

Day.	1			2			3			4		
	1609 1613 1617			1610 1614 1618			1611 1615 1619			1612 1616 1620		
	degr.	mi.	di.	degr.	mi.	di.	degr.	mi.	di.	degr.	mi.	di.
1	18	0		17	57	15	17	53	15	18	4	15
2	18	15	15	18	12	15	18	8	15	18	19	15
3	18	30	15	18	27	15	18	23	15	18	34	15
4	18	45	15	18	41	14	18	38	15	18	49	15
5	18	59	14	18	56	15	18	52	14	19	3	14
6	19	13	14	19	10	14	19	6	14	19	17	14
7	19	27	14	19	23	13	19	20	14	19	30	13
8	19	40	13	19	37	14	19	34	14	19	43	13
9	19	53	13	19	50	13	19	47	13	19	56	13
10	20	5	12	20	2	12	19	59	12	20	9	13
11	20	18	13	20	15	13	20	12	13	20	21	12
12	20	30	12	20	27	12	20	24	12	20	33	12
13	20	41	11	20	38	11	20	36	12	20	44	11
14	20	52	11	20	50	12	20	47	11	20	55	11
15	21	3	11	21	1	11	20	58	11	21	6	11
16	21	14	11	21	11	10	21	9	11	21	17	11
17	21	24	10	21	22	11	21	19	10	21	27	10
18	21	34	10	21	32	10	21	29	10	21	36	9
19	21	43	9	21	41	9	21	39	10	21	46	10
20	21	52	9	21	50	9	21	48	9	21	55	9
21	22	1	9	21	59	9	21	57	9	22	3	8
22	22	9	8	22	7	8	22	5	8	22	11	8
23	22	17	8	22	15	8	22	13	8	22	19	8
24	22	25	8	22	23	7	22	21	7	22	27	8
25	22	32	7	22	30	7	22	28	7	22	34	6
26	22	38	6	22	37	6	22	35	7	22	40	6
27	22	45	7	22	43	6	22	42	7	22	46	6
28	22	51	6	22	49	6	22	48	6	22	52	6
29	22	56	5	22	55	6	22	54	6	22	58	6
30	23	1	5	23	0	5	22	59	5	23	3	5
31	23	6	5	23	5	5	23	4	5	23	8	5

North Declination.

North Declination.

June.

Day.	1			2			3			4		
	1609 1613 1617			1610 1614 1618			1611 1615 1619			1612 1616 1620		
	degr.	mi	di.	degr.	mi	di.	degr.	mi	di.	degr.	mi	di.
1	23	10		23	10		23	8	4	23	12	
2	23	14	4	23	14	4	23	12	4	23	16	4
3	23	18	4	23	17	3	23	16	4	23	19	3
4	23	21	3	23	20	3	23	20	3	23	22	3
5	23	24	3	23	23	3	23	23	3	23	25	3
6	23	26	2	23	26	3	23	25	2	23	27	2
7	23	28	2	23	28	2	23	27	2	23	29	2
8	23	30	2	23	29	1	23	29	2	23	30	1
9	23	31	1	23	30	1	23	30	1	23	31	1
10	23	31	0	23	31	1	23	31	1	23	31	0
11	23	31	0	23	31	0	23	31	0	23	31	0
12	23	31	0	23	31	0	23	31	0	23	31	1
13	23	31	1	23	31	1	23	31	1	23	30	1
14	23	30	2	23	30	1	23	30	1	23	29	2
15	23	28	2	23	29	2	23	29	2	23	28	2
16	23	26	2	23	27	2	23	27	2	23	26	2
17	23	24	3	23	25	2	23	25	2	23	24	3
18	23	21	3	23	22	3	23	23	3	23	21	3
19	23	18	3	23	19	3	23	20	3	23	18	3
20	23	15	3	23	16	3	23	17	3	23	14	4
21	23	11	4	23	12	4	23	13	4	23	10	4
22	23	7	4	23	8	4	23	9	4	23	6	5
23	23	2	5	23	4	4	23	5	5	23	1	5
24	22	57	5	22	59	5	23	0	5	22	56	5
25	22	52	5	22	53	6	22	55	5	22	50	6
26	22	46	6	22	48	6	22	49	6	22	44	6
27	22	40	6	22	41	7	22	43	6	22	38	6
28	22	33	7	22	35	6	22	36	7	22	31	7
29	22	26		22	28	7	22	29	7	22	24	7
30	22	19		22	21	7	22	22		22	17	7

North Declination. *North Declination.*

July.

North Declination.

Day.	1			2			3			4		
	1609 1613 1617			1610 1614 1618			1611 1615 1619			1612 1616 1620		
	degr	mi	di	degr.	mi	di	degr.	m.	di	degr.	mi	di.
1	22	11		22	13	8	22	15	8	22	9	
2	22	3	8	22	5	9	22	7	9	22	0	9
3	21	54	9	21	56	9	21	58	8	21	52	8
4	21	45	9	21	47	9	21	50	9	21	43	9
5	21	36	9	21	38	9	21	41	10	21	33	10
6	21	26	10	21	29	9	21	31	10	21	24	9
7	21	16	10	21	19	10	21	21	10	21	13	11
8	21	6	10	21	8	11	21	11	10	21	3	10
9	20	55	11	20	58	10	21	0	11	20	52	11
10	20	44	11	20	47	11	20	49	11	20	41	11
11	20	33	11	20	35	12	20	38	11	20	29	12
12	20	21	12	20	24	11	20	27	11	20	17	12
13	20	9	12	20	12	12	20	15	12	20	5	12
14	19	56	13	19	59	13	20	2	13	19	53	12
15	19	43	13	19	46	13	19	50	12	19	40	13
16	19	30	13	19	33	13	19	37	13	19	27	13
17	19	17	13	19	20	13	19	23	14	19	13	14
18	19	3	14	19	6	14	19	10	13	18	59	14
19	18	49	14	18	52	14	18	56	14	18	45	14
20	18	34	15	18	38	14	18	41	15	18	30	15
21	18	20	14	18	23	15	18	27	14	18	16	14
22	18	5	15	18	8	15	18	12	15	18	1	15
23	17	49	16	17	53	15	17	57	15	17	45	16
24	17	34	15	17	38	15	17	41	16	17	30	15
25	17	18	16	17	22	16	17	26	15	17	14	16
26	17	2	16	17	6	16	17	10	16	16	57	17
27	16	45	17	16	49	17	16	53	17	16	41	16
28	16	29	16	16	33	16	16	37	16	16	24	17
29	16	12	17	16	16	17	16	20	17	16	7	17
30	15	54	18	15	59	17	16	3	17	15	50	17
31	15	37	17	15	41	18	15	45	18	15	32	18

North Declination.

August.

North Declination.

Day.	1 (1609, 1613, 1617) degr.	mi.	di.	2 (1610, 1614, 1618) degr.	mi.	di.	3 (1611, 1615, 1619) degr.	mi.	di.	4 (1612, 1616, 1620) degr.	mi.	di.
1	15	19	18	15	24	18	15	28	18	15	14	18
2	15	1	18	15	6	19	15	10	18	14	56	18
3	14	43	19	14	47	18	14	52	19	14	38	19
4	14	24	18	14	29	19	14	33	18	14	19	18
5	14	6	19	14	10	19	14	15	19	14	1	19
6	13	47	19	13	51	19	13	56	19	13	42	20
7	13	28	19	13	32	19	13	37	19	13	22	19
8	13	8	20	13	13	19	13	18	20	13	3	20
9	12	49	19	12	54	20	12	58	21	12	43	19
10	12	29	20	12	34	20	12	39	20	12	24	20
11	12	9	20	12	14	20	12	19	20	12	4	21
12	11	48	21	11	54	21	11	59	21	11	43	20
13	11	28	20	11	33	20	11	38	20	11	23	21
14	11	8	20	11	13	21	11	18	21	11	2	21
15	10	47	21	10	52	21	10	57	21	10	41	21
16	10	26	21	10	31	21	10	36	21	10	20	21
17	10	5	21	10	10	21	10	15	21	9	59	21
18	9	44	21	9	49	21	9	54	21	9	38	21
19	9	23	22	9	28	22	9	33	21	9	17	22
20	9	1	22	9	6	21	9	12	22	8	55	22
21	8	39	22	8	45	22	8	50	22	8	33	22
22	8	18	22	8	23	22	8	28	22	8	11	22
23	7	56	22	8	1	22	8	6	22	7	49	22
24	7	34	23	7	39	22	7	44	22	7	27	22
25	7	11	22	7	17	23	7	22	22	7	5	22
26	6	49	23	6	54	22	7	0	23	6	43	23
27	6	26	22	6	32	23	6	37	22	6	20	22
28	6	4	23	6	9	22	6	15	23	5	58	23
29	5	41	22	5	47	23	5	52	22	5	35	23
30	5	19	23	5	24	23	5	30	23	5	12	23
31	4	56	23	5	1	23	5	7	23	4	49	23

Septembe r.

Day.	1			2			3			4		
	1609 1613 1617			1610 1614 1618			1611 1615 1619			1612 1616 1620		
	degr.	mi.	di.	degr.	mi.	di.	degr.	mi.	di.	degr.	mi.	di.
1	4	33	23	4	38	23	4	44	23	4	26	23
2	4	10	23	4	15	23	4	21	23	4	3	23
3	3	47	23	3	52	23	3	58	23	3	40	23
4	3	24	24	3	29	23	3	35	23	3	17	23
5	3	0	23	3	6	23	3	12	24	2	54	23
6	2	37	23	2	43	24	2	48	23	2	31	24
7	2	14	24	2	19	23	2	25	23	2	7	23
8	1	50	23	1	56	23	2	2	24	1	44	24
9	1	27	24	1	33	24	1	38	23	1	20	23
10	1	3	23	1	9	23	1	15	24	0	57	23
11	0	40	24	0	46	24	0	51	23	0	34	24
12	0	16	23	0	22	23	0	28	24	0	10	24
13	0	7	24	0	1	24	0	4	23	0	14	23
14	0	31	23	0	25	23	0	19	24	0	37	24
15	0	54	24	0	48	24	0	43	23	1	1	23
16	1	18	23	1	12	24	1	6	24	1	24	24
17	1	41	24	1	36	23	1	30	23	1	48	23
18	2	5	23	1	59	24	1	53	24	2	11	24
19	2	28	24	2	23	23	2	17	23	2	35	23
20	2	52	23	2	46	24	2	40	24	2	58	24
21	3	15	24	3	10	23	3	4	23	3	22	23
22	3	39	23	3	33	23	3	27	24	3	45	23
23	4	2	23	3	56	24	3	51	23	4	8	24
24	4	25	24	4	20	23	4	14	23	4	32	23
25	4	49	23	4	43	23	4	37	24	4	55	23
26	5	12	23	5	6	24	5	1	23	5	18	23
27	5	35	23	5	30	23	5	24	23	5	41	24
28	5	58	23	5	53	23	5	47	23	6	5	23
29	6	21	23	6	16	23	6	10	23	6	28	23
30	6	44		6	39		6	33		6	51	

North Declination. Equinoctial. South Declination.

North Declination. South Declination.

October.

South Declination.

Day.	1 1609 1613 1617 degr. mi	di.	2 1610 1614 1618 degr. mi	di.	3 1611 1615 1619 degr. mi	di.	4 1612 1616 1620 degr. mi	di.
1	7 7	23	7 1	23	6 56	23	7 13	23
2	7 30	22	7 24	23	7 19	22	7 36	23
3	7 52	23	7 47	22	7 41	23	7 59	22
4	8 15	22	8 9	23	8 4	23	8 21	22
5	8 37	23	8 32	22	8 27	22	8 43	23
6	9 0	22	8 54	22	8 49	22	9 6	22
7	9 22	22	9 16	22	9 11	22	9 28	22
8	9 44	22	9 38	22	9 33	22	9 50	22
9	10 6	21	10 0	22	9 55	22	10 12	21
10	10 27	22	10 22	22	10 17	22	10 33	22
11	10 49	22	10 44	21	10 39	21	10 55	21
12	11 11	21	11 5	22	11 0	21	11 16	22
13	11 32	21	11 27	21	11 21	22	11 38	21
14	11 53	21	11 48	21	11 43	21	11 59	20
15	12 14	20	12 9	20	12 4	20	12 19	21
16	12 34	21	12 29	21	12 24	21	12 40	21
17	12 55	20	12 50	20	12 45	20	13 1	20
18	13 15	20	13 10	20	13 5	21	13 21	20
19	13 35	20	13 30	20	13 26	20	13 41	20
20	13 55	20	13 50	20	13 46	19	14 1	19
21	14 15	19	14 10	20	14 5	20	14 20	20
22	14 34	20	14 30	19	14 25	19	14 40	19
23	14 54	19	14 49	19	14 44	19	14 59	19
24	15 13	18	15 8	19	15 3	19	15 18	18
25	15 31	19	15 27	18	15 22	19	15 36	19
26	15 50	18	15 45	18	15 41	18	15 55	18
27	16 8	18	16 3	18	15 59	18	16 13	18
28	16 26	17	16 21	18	16 17	18	16 31	17
29	16 43	18	16 39	18	16 35	17	16 48	17
30	17 1	17	16 57	17	16 52	18	17 5	17
31	17 18		17 14		17 10		17 22	

South Declination

November.

Day.	1 (1609, 1613, 1617) degr.	mi	di.	2 (1610, 1614, 1618) degr.	mi	di.	3 (1611, 1615, 1619) degr.	mi	di.	4 (1612, 1616, 1620) degr.	mi	di.
1	17	35	16	17	31	16	17	26	17	17	39	16
2	17	51	16	17	47	16	17	43	16	17	55	16
3	18	7	16	18	3	16	17	59	16	18	11	16
4	18	23	16	18	19	16	18	15	16	18	27	16
5	18	39	15	18	35	15	18	31	15	18	43	15
6	18	54	15	18	50	15	18	46	15	18	58	15
7	19	9	14	19	5	14	19	1	15	19	13	14
8	19	23	14	19	19	15	19	16	14	19	27	14
9	19	37	14	19	34	13	19	30	14	19	41	14
10	19	51	13	19	47	14	19	44	14	19	55	13
11	20	4	13	20	1	13	19	58	13	20	8	13
12	20	17	13	20	14	13	20	11	13	20	21	13
13	20	30	12	20	27	12	20	24	12	20	34	12
14	20	42	12	20	39	12	20	36	12	20	45	12
15	20	54	12	20	51	12	20	48	12	20	57	11
16	21	6	11	21	3	11	21	0	11	21	8	
17	21	17	10	21	14	11	21	11	11	21	19	11
18	21	27	11	21	25	10	21	22	11	21	30	10
19	21	38	9	21	35	10	21	33	10	21	40	10
20	21	47	10	21	45	10	21	43	10	21	50	9
21	21	57	9	21	55	9	21	53	9	21	59	9
22	22	6	8	22	4	8	22	2	9	22	8	9
23	22	14	9	22	12	9	22	11	8	22	17	8
24	22	23	7	22	21	8	22	19	8	22	25	8
25	22	30	8	22	29	7	22	27	7	22	33	7
26	22	38	6	22	36	7	22	34	7	22	40	7
27	22	44	7	22	43	6	22	41	7	22	47	6
28	22	51	5	22	49	6	22	48	6	22	5	
29	22	56	6	22	55	6	22	54	6	22	59	5
30	23	2		23	1		23	0		23	4	

South Declination.

South Declination.

December.

Day	1			2			3			4		
	1609 1613 1617			1610 1614 1618			1611 1615 1619			1612 1616 1620		
	deg.	mi.	di.	deg.	mi.	di.	deg.	mi.	di.	degr.	mi.	di.
1	23	7		23	6		23	5		23	8	
2	23	12	5	23	11	5	23	10	5	23	13	5
3	23	16	4	23	15	4	23	14	4	23	17	4
4	23	20	4	23	19	4	23	18	4	23	20	3
5	23	23	3	23	22	3	23	21	3	23	23	3
6	23	25	2	23	25	3	23	24	3	23	26	3
7	23	27	2	23	27	2	23	26	2	23	28	2
8	23	29	2	23	29	2	23	28	2	23	30	2
9	23	30	1	23	30	1	23	30	2	23	31	1
10	23	31	1	23	31	1	23	31	1	23	31	0
11	23	31	0	23	31	0	23	31	0	23	31	0
12	23	31	0	23	31	0	23	31	0	23	31	0
13	23	31	0	23	31	1	23	31	1	23	30	1
14	23	30	1	23	30	2	23	30	1	23	29	1
15	23	28	2	23	28	2	23	29	1	23	27	2
16	23	26	2	23	26	2	23	27	2	23	25	2
17	23	23	3	23	24	3	23	25	2	23	22	3
18	23	20	3	23	21	3	23	22	3	23	19	3
19	23	17	3	23	18	3	23	19	3	23	16	3
20	23	13	4	23	14	4	23	15	4	23	12	4
21	23	8	5	23	10	4	23	11	4	23	7	5
22	23	3	5	23	5	5	23	6	5	23	2	5
23	22	58	5	23	0	5	23	1	5	22	57	5
24	22	52	6	22	54	6	22	55	6	22	51	6
25	22	46	6	22	48	6	22	49	6	22	44	7
26	22	39	7	22	41	7	22	43	6	22	37	7
27	22	32	7	22	34	7	22	36	7	22	30	7
28	22	25	7	22	26	8	22	29	7	22	22	8
29	22	17	8	22	18	8	22	21	8	22	14	8
30	22	8	9	22	10	8	22	13	8	22	6	8
31	21	59	9	22	1	9	22	4	9	21	57	9

South Declination.

South Declination.

By the height of the Pole-ſtar to know the height of the Pole.

THe Tables following are calculated for the end of the year 1610. ſerving without ſenſible error for many years to come; they ſhew the height of the Pole for convenient Latitudes, by the height of the Pole ſtar and the help of the Guards, in eight ſeverall poſitions: ſo that you may by help of them, in any place on the North ſide of the Equator, to the Latiude of 74 degrees, or further, once in three hours every cleer night, make a good Obſervation of the Latitude. In the three laſt poſitions, if the height of the Pole be but little, the Guards will be hid under the Horizon: notwithſtanding if by the hour of the night, or the height of any known ſtar, by the help of a Globe, or Aſtrolabe, wee know when the ſtars doe come to their due poſition, we may Obſerve the Pole ſtar, and find the height of the Pole near as well, as if they were above the Horizon. The Poſitions are carefully to be Obſerved, that the two ſtars mentioned in the head of the Table be either in the ſame Azimuth one directly over another (which is known, if looking with the one eye onely, a perpendicular cord will hide or cover them both) or elſe of the ſame Altitude above the Horizon, which is diſcerned by the Croſſe-ſtaffe. At that inſtant that any ſuch Poſition ſhall happen, take the height of the Pole ſtar; and the Table anſwerable to that Poſition ſhall give you the height of the Pole.

For example; when the greater Guard is directly under the Pole ſtar, I find the height of the Pole ſtar to be 47 degrees and twenty minutes: I looke in the ſeventh Table and find the height of the Pole for 47, to be 44 degrees, 36 minutes: to this I add 20 minutes, becauſe the height of the ſtar is 20 minutes above 47. then is the height of the Pole 44 degrees 56 min. the ſeconds may ſafely be neglected, though they be inſerted in the Table, rather for ſatisfaction of the reader, in the certainty of the Calculation, then for any neceſſary uſe.

If when the greater Guard is in the Eaſt, of equal height with the Pole ſtar, I find the height of that ſtar to be 75 degrees, 40 minutes. In the firſt Table I find the height of the Pole anſwering to 75 deg. to be 77 deg. 26 min. and the difference one degree, three minutes: the part proportionall whereof for 40 mi-

South Declination.

nutes, is 42 min. which added to 77 degrees, 26 min. maketh the true Elevation of the Pole 78 degrees. 8 minutes.

Where the height of the Pole ſtar is but little, there you muſt ſubduct the refraction from the height obſerved: otherwiſe we ſhall alwayes find the height more then in truth it is, this Refraction cauſeth the Obſervations of the Sun at the South, and at the North, (when the Sun never ſetteth in Northern climates) to give ſeverall Latitudes in the ſame place, the Obſervation at the North alwaies making the latitude too great. Concerning this Refraction, ſee page 97.

When the greater guard is in the ſame heighth with the Pole Star.

Heighth of the Pole Star.	Heighth of the Pole.		
Deg.	deg.	mi.	ſe.
1	2	26	49
2	3	27	8
3	4	27	26
4	5	27	44
5	6	28	2
6	7	28	21
7	8	28	40
8	9	28	58
9	10	29	17
10	11	29	36
11	12	29	55
12	13	30	14
13	14	30	33
14	15	30	53
15	16	31	12
16	17	31	32
17	18	31	52
18	19	32	11
19	20	32	32
20	21	32	52
21	22	33	13
22	23	33	34
23	24	33	55
24	25	34	17
25	26	34	38
26	27	35	1
27	28	35	23

Heighth of the Pole Star.	Heighth of the Pole.		
Deg.	degr.	mi.	ſec
28	29	35	46
29	30	36	9
30	31	36	33
31	32	36	57
32	33	37	22
33	34	37	47
34	35	38	13
35	36	38	39
36	37	39	6
37	38	39	34
38	39	40	3
39	40	40	31
40	41	41	1
41	42	41	32
42	43	42	3
43	44	42	36
44	45	43	9
45	46	43	44
46	47	44	20
47	48	44	57
48	49	45	36
49	50	46	15
50	51	46	57
51	52	47	40
52	53	48	25
53	54	49	12
54	55	50	1

Heighth of the Pole Star.	Heighth of the Pole.		
Degr	degr.	mi.	ſec
55	56	50	52
56	57	51	46
57	58	52	42
58	59	53	41
59	60	54	44
60	61	55	50
61	62	57	0
62	63	58	14
63	64	59	33
64	66	0	58
65	67	2	28
66	68	4	3
67	69	5	46
68	70	7	38
69	71	9	40
70	72	11	13
71	73	14	20
72	74	17	0
73	75	19	54
74	76	23	0
75	77	26	19
76	78	29	51
77	79	33	36
78	80	37	36
79	81	41	49
80	82	46	17

When the two guards are of equal heighth betwixt the East and the highest.

Heighth of the Pole Star.	Heighth of the Pole.		
Degr	degr.	mi.	sec.
1	3	46	20
2	4	46	23
3	5	46	25
4	6	46	27
5	7	46	29
6	8	46	31
7	9	46	32
8	10	46	34
9	11	46	36
10	12	46	37
11	13	46	38
12	14	46	39
13	15	46	40
14	16	46	41
15	17	46	42
16	18	46	43
17	19	46	43
18	20	46	43
19	21	46	43
20	22	46	43
21	23	46	44
22	24	46	43
23	25	46	43
24	26	46	42
25	27	46	41
26	28	46	40
27	29	46	39
28	30	46	37
29	31	46	36
30	32	46	33
31	33	46	31
32	34	46	29
33	35	46	26
34	36	46	22
35	37	46	19
36	38	46	15
37	39	46	10
38	40	46	5
39	41	46	0
40	42	45	54
41	43	45	47
42	44	45	40
43	45	45	32
44	46	45	23
45	47	45	14
46	48	45	3
47	49	44	52
48	50	44	39
49	51	44	25
50	52	44	10
51	53	43	53
52	54	43	35
53	55	43	14
54	56	42	51
55	57	42	26
56	58	41	57
57	59	41	26
58	60	40	51
59	61	40	11
60	62	39	26
61	63	38	36
62	64	37	39
63	65	36	34
64	66	35	19
65	67	33	53
66	68	32	14
67	69	30	19
68	70	28	3
69	71	25	21
70	72	22	7
71	73	18	13
72	74	13	30
73	75	7	36
74	76	0	4
75	76	50	17
76	77	36	46
77	78	17	2
78	78	47	20
79			
80			
81			

when

When the greateſt guard is directly above the Pole Star.

Heighth of the Pole Star.	Heighth of the Pole.			Heighth of the Pole Star.	Heighth of the Pole.			Heighth of the Pole Star.	Heighth of the Pole.		
Degr	degr.	mi.	ſec	Deg.	degr.	mi.	ſec	Deg.	degr.	mi.	ſec
1	3	22	29	28	30	21	55	55	57	20	51
2	4	22	28	29	31	21	53	56	58	20	47
3	5	22	27	30	32	21	52	57	59	20	43
4	6	22	26	31	33	21	50	58	60	20	38
5	7	22	25	32	34	21	48	59	61	20	34
6	8	22	23	33	35	21	47	60	62	20	28
7	9	22	22	34	36	21	45	61	63	20	23
8	10	22	21	35	37	21	43	62	64	20	17
9	11	22	20	36	38	21	41	63	65	20	11
10	12	22	19	37	39	21	39	64	66	20	4
11	13	22	17	38	40	21	38	65	67	19	57
12	14	22	16	39	41	21	36	66	68	19	48
13	15	22	15	40	42	21	33	67	69	19	40
14	16	22	14	41	43	21	31	68	70	19	30
15	17	22	13	42	44	21	29	69	71	19	20
16	18	22	11	43	45	21	27	70	72	19	8
17	19	22	10	44	46	21	25	71	73	18	55
18	20	22	9	45	47	21	22	72	74	18	40
19	21	22	7	46	48	21	20	73	75	18	23
20	22	22	6	47	49	21	17	74	76	18	4
21	23	22	5	48	50	21	14	75	77	17	42
22	24	22	3	49	51	21	11				
23	25	22	2	50	52	21	8				
24	26	22	1	51	53	21	5				
25	27	21	59	52	54	21	2				
26	28	21	58	53	55	20	59				
27	29	21	56	54	56	20	55				

When the two guards are directly one over another betwixt the highest and the West,

Heighth of the Pole Star.	Heighth of the Pole.		
Degr	degr.	mi.	sec
1	1	20	22
2	2	20	58
3	3	21	34
4	4	22	11
5	5	22	47
6	6	23	23
7	7	24	0
8	8	24	37
9	9	25	13
10	10	25	50
11	11	26	28
12	12	27	5
13	13	27	43
14	14	28	21
15	15	29	0
16	16	29	38
17	17	30	18
18	18	30	57
19	19	31	37
20	20	32	18
21	21	32	59
22	22	33	40
23	23	34	22
24	24	35	5
25	25	35	48
26	26	36	33
27	27	37	17

Heighth of the Pole Star.	Heighth of the Pole.		
Deg.	degr.	mi.	sec
28	28	38	3
29	29	38	50
30	30	39	37
31	31	40	25
32	32	41	15
33	33	42	5
34	34	42	57
35	35	43	50
36	36	44	44
37	37	45	40
38	38	46	37
39	39	47	35
40	40	48	36
41	41	49	38
42	42	50	42
43	43	51	48
44	44	52	56
45	45	54	7
46	46	55	20
47	47	56	36
48	48	57	55
49	49	59	17
50	51	0	43
51	52	2	12
52	53	3	45
53	54	5	22
54	55	7	4

Heighth of the Pole Star.	Heighth of the Pole.		
Deg.	degr.	mi.	sec
55	56	8	51
56	57	10	44
57	58	12	43
58	59	14	49
59	60	17	2
60	61	19	23
61	62	21	53
62	63	24	34
63	64	27	25
64	65	30	30
65	66	33	48
66	67	37	23
67	68	41	16
68	69	45	30
69	70	50	7
70	71	55	13
71	73	0	52
72	74	7	9
73	75	14	8
74	76	21	52

When the greater guard is in the Weſt, of the ſame heighth with the Pole Star.

Heighth of the Pole Star.	Heighth of the Pole.			Heighth of the Pole Star.	Heighth of the Pole.			Heighth of the Pole Star.	Heighth of the Pole.		
Deg.	degr.	mi.	ſec.	Degr	degr.	mi.	ſec	Deg.	degr.	mi.	ſec
2	0	34	7	29	27	43	27	56	55	0	53
3	1	34	26	30	28	43	52	57	56	2	1
4	2	34	44	31	29	44	18	58	57	3	12
5	3	35	3	32	30	44	44	59	58	4	26
6	4	35	22	33	31	45	11	60	59	5	43
7	5	35	41	34	32	45	39	61	60	7	8
8	6	36	0	35	33	46	7	62	61	8	39
9	7	36	19	36	34	46	36	63	62	10	18
10	8	36	38	37	35	47	6	64	63	12	5
11	9	36	57	38	36	47	37	65	64	13	59
12	10	37	17	39	37	48	8	66	65	16	4
13	11	37	36	40	38	48	40	67	66	18	21
14	12	37	56	41	39	49	15	68	67	20	53
15	13	38	16	42	40	49	49	69	68	23	37
16	14	38	37	43	41	50	25	70	69	26	38
17	15	38	57	44	42	51	2	71	70	29	40
18	16	39	18	45	43	51	40	72	71	33	13
19	17	39	39	46	44	52	21	73	72	37	28
20	18	40	0	47	45	53	3	74	73	42	42
21	19	40	21	48	46	53	46	75	74	49	8
22	20	40	43	49	47	54	31	76	75	56	59
23	21	41	5	50	48	55	17	77	77	6	26
24	22	41	28	51	49	56	7	78	78	17	40
25	23	41	51	52	50	56	59	79	79	30	54
26	24	42	14	53	51	57	53	80	80	46	22
27	25	42	33	54	52	58	49				
28	26	43	2	55	53	59	48				

When the two guards are of equal height betwixt the West and the lowest.

Heighth of the Pole Star.	Heighth of the Pole.			Heighth of the Pole Star.	Heighth of the Pole.			Heighth of the Pole Star.	Heighth of the Poe.		
Deg.	degr.	mi.	sec.	Deg.	degr.	mi.	sec.	Deg.	degr.	mi.	sec.
3	0	13	50	30	27	16	9	57	54	24	47
4	1	13	53	31	28	16	17	58	55	25	31
5	2	13	56	32	29	16	26	59	56	26	19
6	3	14	0	33	30	16	36	60	57	27	12
7	4	14	3	34	31	16	46	61	58	28	10
8	5	14	6	35	32	16	56	62	59	29	14
9	6	14	10	36	33	17	7	63	60	30	26
10	7	14	14	37	34	17	18	64	61	31	45
11	8	14	18	38	35	17	30	65	62	33	14
12	9	14	22	39	36	17	43	66	63	34	54
13	10	14	26	40	37	17	56	67	64	36	47
14	11	14	30	41	38	18	10	68	65	38	57
15	12	14	35	42	39	18	25	69	66	41	26
16	13	14	39	43	40	18	40	70	67	44	22
17	14	14	44	44	41	18	57	71	68	47	48
18	15	14	49	45	42	19	14	72	69	51	48
19	16	14	55	46	43	19	33	73	70	56	40
20	17	15	0	47	44	19	53	74	72	2	46
21	18	15	6	48	45	20	14	75	73	10	39
22	19	15	12	49	46	20	36	76	74	21	29
23	20	15	18	50	47	21	0	77	75	37	16
24	21	15	24	51	48	21	26	78	77	1	13
25	22	15	31	52	49	21	53				
26	23	15	38	53	50	22	23				
27	24	15	45	54	51	22	55				
28	25	15	53	55	52	23	29				
29	26	16	1	56	53	24	7				

When the greater guard is directly under the Pole-ſtar.

Heighth of the Pole Star.	Heighth of the Pole:			Heighth of the Pole Star.	Heighth of the Pole.			Heighth of the Pole Star.	Heighth of the Pole.		
Deg.	degr.	mi.	ſe.	Deg.	degr.	mi.	ſec.	Deg.	degr.	mi.	ſec.
3	0	37	26	31	28	36	51	59	56	35	48
4	1	37	25	32	29	36	50	60	57	35	44
5	2	37	24	33	30	36	48	61	58	35	40
6	3	37	23	34	31	36	47	62	59	35	36
7	4	37	22	35	32	36	45	63	60	35	31
8	5	37	21	36	33	36	44	64	61	35	26
9	6	37	19	37	34	36	42	65	62	35	21
10	7	37	18	38	35	36	40	66	63	35	15
11	8	37	17	39	36	36	38	67	64	35	10
12	9	37	16	40	37	36	37	68	65	35	3
13	10	37	15	41	38	36	35	69	66	34	56
14	11	37	14	42	39	36	33	70	67	34	49
15	12	37	12	43	40	36	31	71	68	34	40
16	13	37	11	44	41	36	29	72	69	34	31
17	14	37	10	45	42	36	27	73	70	34	22
18	15	37	9	46	43	36	25	74	71	34	11
19	16	37	7	47	44	36	23	75	72	33	59
20	17	37	6	48	45	36	20	76	73	33	45
21	18	37	5	49	46	35	18	77	74	33	30
22	19	37	4	50	47	36	15	78	75	33	13
23	20	37	2	51	48	36	13	79	76	32	54
24	21	37	1	52	49	36	10	80	77	32	30
25	22	37	0	53	50	36	7	81	78	32	4
26	23	36	58	54	51	36	5	82	79	31	34
27	24	36	57	55	52	36	2	83	80	30	54
28	25	36	56	56	53	35	58	84	81	30	7
29	26	36	54	57	54	35	55	85	82	29	7
30	27	36	53	58	55	35	52	86	83	27	50

When the two guards are directly one over another betwixt the highest and the West,

Heighth of the Pole Star.	Heighth of the Pole.		
Degr	degr.	mi.	sec
1	1	20	22
2	2	20	58
3	3	21	34
4	4	22	11
5	5	22	47
6	6	23	23
7	7	24	0
8	8	24	37
9	9	25	13
10	10	25	50
11	11	26	28
12	12	27	5
13	13	27	43
14	14	28	21
15	15	29	0
16	16	29	38
17	17	30	18
18	18	30	57
19	19	31	37
20	20	32	18
21	21	32	59
22	22	33	40
23	23	34	22
24	24	35	5
25	25	35	48
26	26	36	33
27	27	37	17
28	28	38	3
29	29	38	50
30	30	39	37
31	31	40	25
32	32	41	15
33	33	42	5
34	34	42	57
35	35	43	50
36	36	44	44
37	37	45	40
38	38	46	37
39	39	47	35
40	40	48	36
41	41	49	38
42	42	50	42
43	43	51	48
44	44	52	56
45	45	54	7
46	46	55	20
47	47	56	36
48	48	57	55
49	49	59	17
50	51	0	43
51	52	2	12
52	53	3	45
53	54	5	22
54	55	7	4
55	56	8	51
56	57	10	44
57	58	12	43
58	59	14	49
59	60	17	2
60	61	19	23
61	62	21	53
62	63	24	34
63	64	27	25
64	65	30	30
65	66	33	48
66	67	37	23
67	68	41	16
68	69	45	30
69	70	50	7
70	71	55	13
71	73	0	52
72	74	7	9
73	75	14	8
74	76	21	52

When the greater guard is in the Weſt, of the ſame heighth with the Pole Star.

Heighth of the Pole Star.	Heighth of the Pole.		
Deg.	degr.	mi.	ſec.
2	0	34	7
3	1	34	26
4	2	34	44
5	3	35	3
6	4	35	22
7	5	35	41
8	6	36	0
9	7	36	19
10	8	36	38
11	9	36	57
12	10	37	17
13	11	37	36
14	12	37	56
15	13	38	16
16	14	38	37
17	15	38	57
18	16	39	18
19	17	39	39
20	18	40	0
21	19	40	21
22	20	40	43
23	21	41	5
24	22	41	28
25	23	41	51
26	24	42	14
27	25	42	33
28	26	43	2
29	27	43	27
30	28	43	52
31	29	44	18
32	30	44	44
33	31	45	11
34	32	45	39
35	33	46	7
36	34	46	36
37	35	47	6
38	36	47	37
39	37	48	8
40	38	48	40
41	39	49	15
42	40	49	49
43	41	50	25
44	42	51	2
45	43	51	40
46	44	52	21
47	45	53	3
48	46	53	46
49	47	54	31
50	48	55	17
51	49	56	7
52	50	56	59
53	51	57	53
54	52	58	49
55	53	59	48
56	55	0	53
57	56	2	1
58	57	3	12
59	58	4	26
60	59	5	43
61	60	7	8
62	61	8	39
63	62	10	18
64	63	12	5
65	64	13	59
66	65	16	4
67	66	18	21
68	67	20	53
69	68	23	37
70	69	26	38
71	70	29	40
72	71	33	13
73	72	37	28
74	73	42	42
75	74	49	8
76	75	56	59
77	77	6	26
78	78	17	40
79	79	30	54
80	80	46	22

When the two guards are of equal height betwixt the West and the lowest.

Heighth of the Pole Star.	Heighth of the Pole.	Heighth of the Pole Star.	Heighth of the Pole.	Heighth of the Pole Star.	Heighth of the Poe.
Deg.	degr. mi. sec.	Deg.	degr. mi. sec.	Deg.	degr. mi. sec.
3	0 13 50	30	27 16 9	57	54 24 47
4	1 13 53	31	28 16 17	58	55 25 31
5	2 13 56	32	29 16 26	59	56 26 19
6	3 14 0	33	30 16 36	60	57 27 12
7	4 14 3	34	31 16 46	61	58 28 10
8	5 14 6	35	32 16 56	62	59 29 14
9	6 14 10	36	33 17 7	63	60 30 26
10	7 14 14	37	34 17 18	64	61 31 45
11	8 14 18	38	35 17 30	65	62 33 14
12	9 14 22	39	36 17 43	66	63 34 54
13	10 14 26	40	37 17 56	67	64 36 47
14	11 14 30	41	38 18 10	68	65 38 57
15	12 14 35	42	39 18 25	69	66 41 26
16	13 14 39	43	40 18 40	70	67 44 22
17	14 14 44	44	41 18 57	71	68 47 48
18	15 14 49	45	42 19 14	72	69 51 48
19	16 14 55	46	43 19 33	73	70 56 40
20	17 15 0	47	44 19 53	74	72 2 46
21	18 15 6	48	45 20 14	75	73 10 39
22	19 15 12	49	46 20 36	76	74 21 29
23	20 15 18	50	47 21 0	77	75 37 16
24	21 15 24	51	48 21 26	78	77 1 13
25	22 15 31	52	49 21 53		
26	23 15 38	53	50 22 23		
27	24 15 45	54	51 22 55		
28	25 15 53	55	52 23 29		
29	26 16 1	56	53 24 7		

When the greater guard is directly under the Pole ſtar.

Heighth of the Pole Star.	Heighth of the Pole:		
Deg.	degr.	mi.	ſe.
3	0	37	26
4	1	37	25
5	2	37	24
6	3	37	23
7	4	37	22
8	5	37	21
9	6	37	19
10	7	37	18
11	8	37	17
12	9	37	16
13	10	37	15
14	11	37	14
15	12	37	12
16	13	37	11
17	14	37	10
18	15	37	9
19	16	37	7
20	17	37	6
21	18	37	5
22	19	37	4
23	20	37	2
24	21	37	1
25	22	37	0
26	23	36	58
27	24	36	57
28	25	36	56
29	26	36	54
30	27	36	53

Heighth of the Pole Star.	Heighth of the Pole.		
Deg.	degr.	m'.	ſec.
31	28	36	51
32	29	36	50
33	30	36	48
34	31	36	47
35	32	36	45
36	33	36	44
37	34	36	42
38	35	36	40
39	36	36	38
40	37	36	37
41	38	36	35
42	39	36	33
43	40	36	31
44	41	36	29
45	42	36	27
46	43	36	25
47	44	36	23
48	45	36	20
49	46	36	18
50	47	36	15
51	48	36	13
52	49	36	10
53	50	36	7
54	51	36	5
55	52	36	2
56	53	35	58
57	54	35	55
58	55	35	52

Heighth of the Pole Star.	Heighth of the Pole.		
Deg.	degr.	mi.	ſec.
59	56	35	48
60	57	35	44
61	58	35	40
62	59	35	36
63	60	35	31
64	61	35	26
65	62	35	21
66	63	35	15
67	64	35	10
68	65	35	3
69	66	34	56
70	67	34	49
71	68	34	40
72	69	34	31
73	70	34	22
74	71	34	11
75	72	33	59
76	73	33	45
77	74	33	30
78	75	33	13
79	76	32	54
80	77	32	30
81	78	32	4
82	79	31	34
83	80	30	54
84	81	30	7
85	82	29	7
86	83	27	50

When the two guards are in the ſame Azimuth, or the one directly over the other betwixt the loweſt and the Eaſt.

Height of the Pole Star.	Height of the Pole.		
Deg.	degr.	mi.	ſec.
1	0	40	50
2	1	41	27
3	2	42	3
4	3	42	39
5	4	43	16
6	5	43	52
7	6	44	29
8	7	45	6
9	8	45	43
10	9	46	20
11	10	46	58
12	11	47	36
13	12	48	14
14	13	48	52
15	14	49	31
16	15	50	10
17	16	50	50
18	17	51	30
19	18	52	10
20	19	52	52
21	20	53	33
22	21	54	15
23	22	54	58
24	23	55	42
25	24	56	26
26	25	57	11
27	26	57	57
28	27	58	43
29	28	59	31
30	30	0	19
31	31	1	9
32	32	1	59
33	33	2	51
34	34	3	44
35	35	4	39
36	36	5	34
37	37	6	32
38	38	7	30
39	39	8	31
40	40	9	33
41	41	10	38
42	42	11	44
43	43	12	53
44	44	14	4
45	45	15	17
46	46	16	33
47	47	17	53
48	48	19	15
49	49	20	41
50	50	22	11
51	51	23	45
52	52	25	23
53	53	27	5
54	54	28	54
55	55	30	47
56	56	32	47
57	57	34	54
58	58	37	9
59	59	39	34
60	60	42	4
61	61	44	46
62	62	47	41
63	63	50	48
64	64	54	11
65	65	57	51
66	67	1	49
67	68	6	11
68	69	10	59
69	70	16	16
70	71	22	11
71	72	28	54
72	73	36	34
73	74	45	18
74	75	55	14

An Addition

touching the Variation of the Compaſſe.

WHeras there have bein ſome of opinion that there be two Magnetical Poles, by knowledge whereof, and of the Magnetical Variation Obſerved in any place, they have imagined they could find the Longitude thereof: to ſhew the great error and uncertainty of this their opinion, I have here ſet down this Table of obſervations of the Variation of the Magnetical Needle, which partly by my ſelf but for the moſt part by others, both Engliſh and ſtrangers, have bin taken in all parts of the World almoſt, whither any Navigation hath bin made, for theſe many years. Which Obſervations I wiſh the Juditious Reader to compare together, with ſo good advice and judgment as he can: whereby I aſſure my ſelf he will be enforced to acknowlege with me that there can be no ſuch Magnetical Poles found; as they imagine. To prove theſe, a few inſtances may be ſufficient amongſt many that may be gathered out of theſe Obſervations. For if there be two ſuch Magnetical Poles, there can be but one common Magnetical Meridian paſſing by them and the poles of the World: but by theſe Obſervations it is manifeſt that there be many Magnetical meridians paſſing by the Poles of the World: as namely the Magnetical Meridian about *Trinidado* and *Barbudas*: alſo the Meridian about the Weſtermoſt of the *Azores* alſo about *P. das Agulhas*: laſtly amongſt the Eaſt Indian Ilands ſome what beyond *Iava Maior*, the magnetical and true meridian muſt needs agree in one. Now ſeeing that all theſe Magnetical Meridians paſſe by the Poles of the World there can be no reaſon given why the magnetical Poles ſhould be ſaid to be in one of them more then in another: and if in any, then in all: whereof it muſt needs follow, that as many Magnetical Meridians as you have that paſſe by the Poles of the World, ſo many paire of Magnetical Poles muſt you have, which is abſurd; and therefore no ſuch Magnetical Poles.

Now if any shall think that the great difference that is found betwixt divers of these Observations, taken at the same place by divers Observers, doth make any thing against the intention of this Argument, he is much deceived. For although there be three or four degrees difference betwixt some Observations taken at the same place; as namely at *S. Helena*, some make the Variation to be almost three degrees, some almost four, others will have it to be about five degrees and an half, and some others seven and an half. And although there be some four or five score leagues difference in determining the place where the true and Magnetital Meridian should concur, or where there should be no variation about *Flores* and *Corvo*, and about *P. das Agulhas*, some making to be about seventy or eighty leagues Westward from *Flores*; and some about thirty leagues Eastward from thence; where some others will have it hard by *Flores*, or somewhat to the Eastwards thereof: And at *P. das Agulhas* some say there is no variation at all, but according to others we must goe 80 leagues further to the Eastward before we come to no variation. All these differences notwithstanding how great soever they be, can be of no validity to infringe the force of the foresaid argument; for still these Observations will necessarily prove, that either at *Flores* and at *P. das Agulhas*, or at the most, within three or four score leagues of those places, there is a Magneticall Meridian passing by both the Poles of the World; which two Meridians differing so much in Longitude each from other, and having in all Latitudes great variations betwixt them, it cannot be with any reason imagined how they may be reduced into one, so to make two Magnetical Poles only. But of all these so great differences either of the same or of divers mens Observations, we may justly take occasion to admonish all Seamen, especially such as are to take charge, that they be very carefull both in providing themselves of the most convenient Instruments that can be gotten for this purpose, and also in the circumspect and artificiall handling of them whensoever they goe about to make use of them in Observing to find the variation, considering how great and excellent use there may be made hereof, for finding out the place whereabouts you are betwixt East and West upon the huge and vast Ocean, though you have seen no land for a long time.

	Variat. West.		Latit. North.	
	De.	M	De.	M.
In the Ice Haven at Nova Zembla	22	30	76	0
On the West side of Nova Zembla	26	0	76	0
From Nova Zembla Westward 20 leagues	31	0	73	0
At Crosse Iland near Nova Zembla	17	0		
At the Hollanders Newland	16	0	81	0
In the Iland of Vaygats	7	0	71	0
Amongst the Iles of Vaygats	8	0	70	25
At S. James Ile	7	30	70	40
On Land near the bar of Pechora	3	30	69	10
At the North Cape	1	0	71	30
From Fowlay Iland half way almost to Friseland	11	15		
From Friseland half way to Labrador, now called Newfoundland	28	0	62	0
	East.			
Near England sayling from Yarmouth Northwards	12	40	55	14
	13	0	55	20
	West.			
	3	30	69	0
	7	0	70	40
In the way from London to Russia	8	0	70	30
	East.			
	4	0	65	40
	5	10	64	30
	3	0	66	30
At Antwerpe in Brabant	9	0		
Near London at Limehouse	11	0	51	30
	11	15		
About Portland	10	0		
In S. Ives Churchyard in Cornwall	8	0	50	30
From Cape Lizard South by West 8 leagues	12	50	49	55
South Easterly from C. Clear comming from our Channel	7	36		
At Youghall in Ireland	10	0		
At Sylly	10	0		

	Variat. East. De. M.	Latit. North. De. M.
From Bell Ile East-ward 350 leagues	1 0	52 10
From Syllie West Northwest 235 leagues	0 0	54 0
	West.	
From Syllie West Northwest five hundred and thirtie leagues	10 0	60 0
From that place Northwest by North	16 0	63 30
From thence North and by West	22 0	66 0
From this last place North by West	28 0	73 0
From thence due West 40 leagues	33 0	73 0
At the Earle of Cumberlands Iles	30 0	64 0
At Hope Sanderson	28 0	72 12
At Cape Rase in Newfoundland	16 0	47 0
From Cape Rase South by West Southerly	2 52	34 35
	5 35	35 30
From C. Rase South Southwest Southerly	6 30	39 40
	East.	
At Cape Finister	8 30	
From Cape Finister west by North 38 leagues	7 55	43 20
From the Rock Westward about 50 leagues	6 15	39 10
From the Rock West Northwest 7 leagues	7 0	
About Lisbone	6 30	
From Lisbone to Cape Verde almost	8 30	
From C. Saker 3 or 4 leagues Eastward	5 38	
From S. Maries (one of the Azores) 9 leagues East by South	2 20	
At Fayal, and from thence to Tercæra	3 45	
From Tercæra to Lisbon	7 30	
	8 30	
From Flores Eastward scarce 40 leagues, and from C. Blanco 300 leagues	4 0	
From Flores Eastward 70 or 80 leagues	0 0	
Hard by Flores or betwixt it and Fayal	0 0	
From Flores Westward 30 leagues	0 0	
	West.	
Crossing the Meridian of Flores and Corvo	1 0	
From Flores 100 or 120 leagues Westward	2 0	
	1 0	
Within sight of Flores Southeast from thence	5 37	

From

	Variat. East. De. M	Latit. North. De. M.
From Flores West 230 leagues	3 30	39 19
Falling with the Pike	1 30	
From the Canaries 300 leagues	1 0	19 0
	East.	
At the Canaries	5 37	
From the Grand Canarie Northward	4 37	32 0
Northeast from the Ile Salvages	5 37	31 0
On the Southwest side of the Grand Canarie	5 20	28 0
From the Canaries 230 leagues	0 0	20 0
Sailing for the Canaries from the West Indies	0 0	33 0
	0 0	31 0
Sailing further in	5 37	27 20
From Palma Sailing towards Cape Blanco	3 0	24 0
Near to C. Blanco not two leag. from shore	2 40	21 0
Riding at anchor near C. Blanco	3 0	20 25
From C. Blanco West S.w. some 20 leagues	2 40	
From C. Blanco Westward 63 leagues	5 37	19 20
From C. Blanco Westward 90 leagues	5 0	18 35
From C. Blanco Westward 100 leagues	6 0	
From C. Blanco 436 leagues	7 30	17 42
From C. Blanco 470 leagues	7 30	11 57
From C. Blanco 476 leagues	7 36	16 35
From C. Blanco 535 leagues	7 30	10 59
From C. Blanco 595 leagues	5 0	10 15
From C. Blanco 640 leagues	4 36	10 0
From C. Blanco 700 leagues Westward	1 3	9 20
From C. Blanco going towards the West Indies in many distances	6 0	
	5 40	14 54
At Cape Verde	7 0	
About the Ilands of C. Verde	4 0	
From these Ilands 300 leagues Westward	5 38	
At S Jago and S. Nicholas Iles of C. Verde	2 30	
From C. Verde 100 or 120 leagues	3 45	14 0
From the Iles of Brava & Fogo W.N.w. 12 leag.	4 30	
From Maio 46 leagues East by South	5 8	14 20
From Cape Verde in the way to the East Indies passing the Equinoctial	4 0	
	5 0	
	5 37	

At

	Variat. East. De.	M	Latit. North. De.	M
At the Iland of Trinidado	0	0	9	46
From Trinidado Iland Eaſtw. 90 leagues	1	30		
	2	0		
	Weſt.			
At Margarita	0	0		
At S. Cruce near S. John de Porto Rico	0	0		
At Cape Roſſe of S. Johns Iland	1	52	17	44
In the Meridian of Porto Rico	2	52	21	30
At anker on the Weſt ſide of S. John	1	52		
At the Weſt end of S. John de Porto Rico	2	30	17	44
From S. John de P. Rico North Northweſt northerly half a point	8	0	23	0
Alſo in the ſame courſe	8	0	26	0
Again in the ſame courſe	8	0	26	20
From Dominica about ſome 140 leagues	0	0	14	0
In the Meridian of Barbados fiftie leagues from Martinico	0	0	14	20
At the Iland of Guardelupo	1	0	15	18
At Curſands an Iland of the Weſt Indies	4	0	12	13
At the town of Rio de Hacha	7	36	11	20
At Cape la vela	7	0	11	50
Thwart Rio de Mayo	15	0	31	0
	15	0	36	0
At Cape Codera	2	30	9	30
At Cape Corientes in Cuba	3	0		
At Cape S. Anthonie in Cuba	13	0	22	0
At Cape Cameron	5	0	25	40
At Cape Florida	3	0	25	30
To the Northward of the Cape of Florida	13	0	28	0
Near the coaſt of America	11	0	35	30
From Barmudas Weſtward 140 leagues	10	0	30	35
From Barmudas Weſtward 100 leagues	10	3	34	0
Again from Barmudas 80 or 85 leagues	11	15	34	0
From Cape Raſo S. Southweſt Southerly	6	30	39	40
	Eaſt.			
From Serraleona Weſt by South, and from the ſhoalds of Madrabombe or S. Anne Weſt and by North 160 leagues	6	10	7	0

In

		Varia. West.		Latit. South.	
		De.	M	De.	M
In the harbour of Serraleona		1	50	8	30
From the shoar of Serraleona 17 leagues		2	23	3	54
From Serraleona 61 leagues VVest Southerly		2	56	7	58
	76	3	29	7	25
	97	3	45	6	0
	153	4	20	4	50
	137	4	12	4	40
	127	3	56	4	30
	142	4	20	4	18
	160	4	58	4	6
From the Meridian of Sierraleona 187 leagues VVestward	187	4	50	3	0
	187	5	40	1	50
	194	5	45	0	45
				South.	
	195	5	26	0	10
	198	5	30	0	35
	206	6	33	2	0
	210	6	55	2	35
	220	6	45	3	35
From C.S.Auguſtine North and by VVeſt		7	0	7	16
From C.S.Auguſtine North by East Eaſterly		6	40	1	4
From C.S.Auguſtine North Northeaſt		8	0	4	0
From Cape S.Auguſtine East Northerly 30 leagues		8	10	8	20
From C.S.Auguſtine 100 leagues		11	6	8	30
From C.S.Auguſtine not 120 leagues		5	37	11	30
At the Ile Fernando Laronho near Braſil		8	30	2	20
Cloſe by the coaſt Braſil		3	45	7 8 10	0 0 0
A little VVeſt from the Meridian of Trinidad near Braſil		11	10	18	30
Among the Ilands of Trinidad and Aſcenſion		12	8	20	35
On the backſide of the Ile of Aſcenſion		12	10	20	30
At the Ile of Aſcenſion		10	0	20	0
In the Meridian of Trinidad Eaſterly		14	53	27	0
Between the Iles of Trinidad and Triſtan de Acunha	18 19	0			

	Varia. East. De.	M	Latit. South. De.	M
From the ſhoalds of Braſil Eaſt Southerly about 14 leagues	12	30	19	30
From the ſame ſhoalds South-eaſt about 55 leagues	13	52	20	10
Alſo from the ſame ſhoalds Southeaſt by Eaſt	13	20	19	37
From the coaſt of Braſil 150 leagues	10	0	18	0
At Cape S. Vincent in Braſil	12	0		
From the coaſt of Braſil 100 or 120 leagues	8	30	17	0
	7	30	18	0
From Laronho Southweſt 12 leagues	8	1	4	20
From Aſcenſion Ile 20 or 30 leagues Eaſtward at the Cliffe Penedo de S. Pedro	5	30		
Betwixt Aſcenſion Ile and S. Helens	7	30		
At S. Helena	2	48		
	3	46		
	5	37		
	7	30		
From S. Helena a little VVeſtward	9	0		
From S. Helens not 19 leagues	5	40	18	30
From S. Helena northweſt by VVeſt 16 leagues	3	45		
From S. Helena northweſt 156 leagues	7	40	10	20
From S. Helena 230 leagues	5	38	8	20
From Aſcenſion Ile northeaſt half a point northerly about 12 leagues	6	0		
About the Ilands of Martin Vaz	13	0	19	6
Alongſt by thoſe Iles	11	15		
From thoſe Ilands northerly 30 leagues	18	30		
From the ſhoare of Africk VVeſtward ſome 130 leagues	4	8	27	0
Bearing from thence toward S. Helena	2	48	25	0
From the main of Africa 160 leagues	2	50	23	0
In the Longitude of 28 degrees	15	20	32	0
A little VVeſtward from the Meridian of the Iles of Martin Vaz	14	58	28	35
Eaſtward from thence	15	37	28	53
From the former Obſervation 60 leagues	16	8	29	0
From the laſt Obſervation Eaſtward 27 leagues	16	52	29	33

Beyond

	Varia. Eaſt. De. mi.	Latit. Sonth. De. mi.
Beyond Triſtan da cunha 70 or 80 leagues comming from Martin Vaz	16 53	33 0
From Triſtan da cunha VVeſtward	17 52	
	14 0	34 35
At the Iland of Triſtan da cunha	19 0	
From thence northward	16 8	33 34
Paſt the Iland towards C. Bona Speranza	14 0	
From Triſtan da cunha VV. n. VV. 368 leagues	14 0	28 25
At Cape Frio	13 0	
Near Cape Frio	12 0	23 30
From Cape Frio Eaſtward towards Africa	17 0	
	18 0	
From Cape Frio about 125 leagues Eaſtward	11 8	
About 155 leagues from Cape Frio	14 8	25 0
At Port deſire	5 0	47 40
At the Eaſt mouth or entrance into Magellans ſtraits	5 30	
In the ſtraits of Magellan	5 0	
From Cape Bonæ ſpei 900 leagues VVeſt by north half a point northerly	15 52	26 50
From Cape Bonæ ſpei almoſt VVeſt by N. 180 leagues	8 50	34 0
At the bay of Soldania	0 20	33 55
	1 30	33 20
At Cape Buona Eſperanza	0 15	
	1 30	
About Cape Buona Eſperanza	2 0	35 0
From Cape Buona Eſperanza VVeſtwards 30 or 40 leagues	5 38	
Betwixt C. Buona Eſperanza and S. Helena	3 45	
From C. Buona Eſperanza *South*	3 45	
From C. Bona Speranza VVeſtward 40 or 50 leagues	3 0	
From C. Buona Eſperanza due northweſt	5 37	20 0
	Weſt.	
From C. Bonæ ſpei S.w. by S. 36 leagues	4 10	35 25
From C. Bonæ ſpei S.w. by S. 28 leagues	3 50	35 30

	Varia. East.		*Latit. South.*	
	De.	*mi.*	*De.*	*mi.*
At Cape das Agulhas near C. Bonæ ſpei	0	0		
From thence 80 leagues Eaſtward	0	0		
At Cape Talhada 40 leagues Eaſt from Cape das Agulhas, being in ſight of land lying from us north by Eaſt	3	47	34	20
At C. Corientes beyond C. Bonæ ſpei	7	30		
	11	0	25	0
From C. Corientes Southwards	8	30	30	30
About the Ilands Primeras towards Mozambique	15	0	18	0
In the Ile Mozambique	12	0	14	45
			North.	
At the Iles of Nicobar	7	36	7	30
	10	0		
From thence till you come to the Line going towards the Eaſt Indies	11	0		
At the Ile de Almirant near the line	13	0		
Near to C. Guarda fui, or Porto Galeacea	8	15	13	15
At P. de eſtreito or the mouth of the Red ſea	5	15	12	15
At Baxos de Cuaquem	1	15	19	15
At Port de Igidid	0	40	22	0
At Xuarit	0	15		
	Eaſt.			
At Sidon in the bottom of the ſtraigts	2	35	33	30
	Weſt.		*North.*	
From the place that is 200 leagues Weſtward from Goa to Cape Comorin	15	0		
At Goa	15	0	15	20
At the Iles Comoro	13	0		
In the Bay of S. Auguſtine in Madagaſcar	15	0		
At Cape Romano in Madagaſcar	17	40	26	0
Near Madagaſcar	8	30	26.0	
			20.0	
From Cape Romano Southerly	14	4	27	
			30	
From C. Romano VVeſt Southweſt half a point Southerly 119 leagues	14	14	36	34

From

	Variat. East.		*Latit. North.*	
	De.	*M*	*De.*	*M.*
From C. Romano Southwest 50 leagues	15	25	28	20
In the heighth of C. Romano 8 leagues off	16	45	25	50
At the Ile of S. Mary entring the Bay of Antongil	17	0	17	0
In the bottome of the Bay of Antongil by many and exact Observations	20	0		
At the Bay of Tanassarin	5	30		
At the VVest side of the sands of Saya de Malha	15	0	11	30
At the Iland Ragapez	22	11	10	0
From the Iland of Gratia West S.w. 36 leagues	24	11	9	20
At the shoalds called Baixos de India	8	30	30	0
At Diego Roiz Iland	21	0	20	0
From Los Romeros Iles South VVesterly 68 leag.	24	15	31	0
From Los Romeros East by South 50 leagues	22	16		
From Los Romeros East 110 leagues	21	20		
At the shoalds of Adu and Candu	19	30	6	0
At the Ile Diego Gratiosa	24	0	9	0
From Diego Gratiosa Westward 20 leagues	22	0	7	30
At Diego Roderigos Iland	20	0		
From Diego Rodericos Iland South, and South and by East	23 24 25		35	0
At Maldiviæ Ilands	17	0		
			North.	
At Cochin	13	0	9	40
From Cochin till you be past Maldiviæ Iles South and Southwest till you bé under 8 and 10 deg. of South Latitude	16	52		
At Zeilan	15	30	9	0
At the Ile Pulobatum	4	0	4	
At Achin in Sumatra	8	0		
In the Roade of Achin	6	30		
			South.	
In Priaman on the VVest side of Sumatra	5	40	0	22
At Bantam in Java	5 4	0 30	7	0
At Madura	2	30	6	50
At the Northeast corner of Balij	3	0	8	30
At Banda	4	45	4	50

FINIS.

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The Haven-finding Art,

Or

The way to find any Haven *or place appointed at* Sea.

THere is no man, I ſuppoſe, that knoweth not with how great diligence now of a long time (eſpecially ſince men leaving no part of the world unattempted, have ſayled into *America*, and to the utmoſt *Indies*) the ſearchers out of excellent things have ſought ſome certain way, whereby they which take charge of Ships might know aſſuredly the ſituation and Longitude of what place ſoever they would goe unto, and ſo come to any Haven or place appointed at Sea. But I know not how it hath come to paſſe, that there could not hitherto any certain knowledge of that matter be attayned unto. For ſome when they indevoured to find this thing by the magnetical needle gave the Load-ſtone it ſelf a Pole, which of the Load-ſtone (called alſo the Magner) they named the Magnetical Pole, or Pole of the Load-ſtone. But that this is otherwiſe, the thing it ſelf hath taught us, becauſe the variation of the needle is found not to follow the Rule of that Pole. Yet in the mean time this continual ſearching gave occaſion of another mean whereby a Ship might certainly direct her courſe unto any

Haven or place at Sea whereto you would desire to go, although the true Longitude both of the place wherein the Ship is, as also of the place where the Haven is, were both unknown. Which that it may in some sort be rudely shewed, and that the circumstances hereof may more clearely be set forth before your eyes, whereby there may ensue a more certain and general use of the same, first of all it must be known that we are taught by dayly experience, that the Magnetical Needle touched with the Loadstone or Magnet (which therefore we call the Magnetical needle) doth not always point out the same part of the world, but without any respect of that Magnetical Pole, (wherof we made mention before) sometimes indeed it sheweth the true place of the North: but for the most part it declineth either towards the East or West: which variation, yea even in a smal distance of places, hath most manifestly appeared to them which have directed their course from the Easterne parts towards the West: For examples sake at *Amsterdam* the variation is 9 degrees and 30 min. towards the East. In the Foreland of *England* 11 degr. At *London* 11 degr. 30 min. Near *Tinmouth* in the Sea 12 degr. 40 min. and so forth.

How any Haven or place at Sea may be found, the Latitude and variation of the same place only being known.

THe variation of the Magnetical Needle and the Latitude of the place being known the same place may be found although the Longitude be unknown, and that dayly experience plentifully teacheth. For (that we may make this matter plain by examples especially) if the Mariner know that the Latitude of the Citie of *Amsterdam* is 52 degr. and 20 min. and that the variation of the Compasse in the same place is 9 deg. and 30 min. he must needs not be ignorant, that when he hath brought himself to that Latitude and variation, he is not far from *Amsterdam*, what Longitude soever that Citie have. But some man may object, that there are many places which have the same Latitude and variation that the Citie of *Amsterdam* hath: whereto we may readily answer that indeed there be such places: but yet very far distant from thence, and such as may easily be known by other circumstances, whereof we shall speake hereafter. And although the Mariners may find *Amsterdam* otherwise, as by the places near adjoining, by conjectures,

jectures by the soundings, by the sands, and many other signes, without any regard of the variation: yet I thought good to propound a known place for example, that the Universality of the same Rule might be known in long Navigations, wherein no land appeareth. As for example if the Master of a ship desire to sayle from hence to Cape *S. Augustine* in *Brasile*, and know that the variation there (as it is reported) is 3 deg. and 10 min. and the Latitude 8 deg. 30 min. towards the South, when in going thitherwards he shall come to that Latitude, and variation, he shall then know that he is come to the Cape of *S. Augustine*: and although he think otherwise by his conjecture, and reckoning yet not regarding that conjecture he shall confess himself either to have guessed ill, or els to have been deceived with some Eastern or western currents: For reason will not suffer us to think that that variation which before was found at the Cape of *S. Augustine* is changed, that he should need to yeeld himself to that opinion. So also who will not esteem it to be absurd, and altogether against reason, that he which knoweth very well that he findeth at sea another variation then that which is at Cape *S. Augustine*, of 3 degr. 10 min. should notwithstanding neglecting the experience of the variation, and resting upon conjecture onely affirme that he is neer the Cape *S. Augustine*? Because he speaketh contrary things, when he saith that the variation there is 3 degrees 10 minutes, and again avoucheth that it is not.

Neither is this unworthy the marking which hath often happned, that he which should have sailed to the Isle of *S. Helena* when he was come to the Latitude of the same Iland, and saw not there the Iland, and was also ignorant whether he were to the Eastwards or Westward from the same, by conjectures sought that place towards the East, which indeed lay from him towards the West: and so the further he sailed the further always he went from that Iland. Now I leave it to thy consideration if he, (whosoever he were that was Master of that ship, which diligently sought that Iland for the space of cerain weekes, tacking about also divers times before he could find any place to abide in) if he I say had not been ignorant what the variation of the Compasse was at *S. Helens* Iland, and what the use of the variation is at sea, and how to find it out I leave it I say, to thy consideration, whether he would willingly have floated doubtfully to and fro following a greater variation, knowing assuredly that the variation there was lesser.

Hereby it may easily be conceived how great use there is of the

variation, when they especially which in sayling follow the lines shewing the courses (which lines because now they have found this name among the Portugales we call Rumbs, the ignorance of which (lines) can hardly be permitted in them which attempt long voyages upon the huge Ocean)ought every where to know certainly the place of the true North, which is commonly found by the knowledge of the variation.

If any man likewise consider the uncertain situation of those places which are set into Globes or Sea Charts by the mariners relation, which uncertainty taketh his beginning from hence, because every man thinketh that to be the true place of the North which is shewed by the Flower deluce (as they call it) of the Compass which they brought with them from home, (which thing also bringeth no less doubtfulness to the Mariners themselves) he will think (and that not without cause)that the Observation of the variation is a very needfull thing even for this cause also: Because it is an easie matter to place the flower-deluce in such sort that it shall not miss any thing in shewing the true North part of the World, to wit, if one move the Magneticall needle or points of the wires in the Compasse from the flower-deluce so much as need shall require.

These things therefore have been Observed and granted, and this especially,that the variation altereth according to the variety of countries,(as by the common testimonie of all men it is proved) it is in some sort manifest that they which denie this varying property to be of very great use for Navigation,are either wiser then the common sort, and have some hidden secrets which are not revealed to every man, or else are notable fooles and mad men.

Therefore when the most excellent Prince *Maurice*, having throughly considered hereof, thought that it might assuredly be brought to that pass that Mariners might receive great profit by this means, He (the high Admirall) gave commandment to all the companies of the Admiralty (adjoyning also thereto a certain introduction) that they should doe their best indevor, that all Masters of ships should provide themselves for this purpose: that is to say. that to what place soever they should come, they should seek out the Declination of the Magneticall needle from the North, or the variation of the Compasse, not lightly, running over the matter as it were by the way, and for fashions sake onely; but with great carefulness and diligence, taking with them meet and needfull Instruments for that purpose: and that after their return into their own countrey they should truly and faithfully

faithfully certifie their companies or brotherhoods of the Admiralty of that matter: that the selfe same experiments being by them brought into good order, might be published for the common good.

But that every man may more perfectly learn the circumstances of this matter, I thought it meet here to set down certain principles of this thing, which is yet notwithstanding to be further searched into by more experiments, in which shall be shewed a generall view or Table of those places, whose variations have already been Observed by the learned Geographer *Petrus Plancius*, with continual labour, and not without great charges, from divers corners of the earth neer and farr off: whom for honours sake I therefore name, that as well they that shall hereafter find out places or havens after this manner, as also they that have already found, may know that they are bound to give thanks to *Plancius* alone, as to him that is the chief cause of this Observation. But that Table or generall view of variations, whereof there shall hereafter follow a plainer declaration is this.

			North-easting. Deg.	M	Latitude Deg.	Mi	Longitude. Deg.	Mi.
The North-easting, or the East variation of the first part or space towards the North.	Increasing.	In the Flemish Iland *Corvo*	0	0	N 37	0	0	0
		In the Flemish Iland *Saint Mary*	3	20	N 37	0	8	20
		Near the Iland *Maio*	4	55	N 15	0	11	20
		At *Palma* one of the *Canary* Ilands	6	10	N 28	30	16	20
		At the Rock near *Lisbon*	10	0	N 38	55	24	30
		In the Westermost part of *Ireland*	11	0	N 52	8	24	12
		In the West part of *England*	12	40	N 50	21	28	0
	Decreasing.	About one mile Eastward from *Plimmouth*	13	24	N 50	18	30	0
		By *Tinmouth* in the Sea	12	40	N 55	0	33	0
		At *London* in *England*	11	30	N 51	24	34	6
		In the Foreland of *England*	11	0	N 51	8	35	40
		In *Amsterdam*	9	30	N 52	20	39	30
			North-westing					
The North-westing, or the West variation of the second part or space towards the North	Increasing.	At *Helmshade* to the westward from the North *Cape* of *Finmarke*	0	0			60	0
		At the North *Cape* of *Finmarke*	0	55	N 71	25	61	30
		At *Norquinda*	2	0	N 71	10	63	30
		At S. *Michael* or *Archangel* in *Russia*	12	30	N 64	54	83	30
		In the South streight of *Vaigatz*	24	30	N 69	30	103	0
		At *Langeness* in *Nova Zembla*	25	0	N 73	20	100	30
	Decreasing.	In *Williams* Iland	33	0	N 75	35	110	0
		At *Tshouck* In *Nova Zembla*	27	0	N 77	12	120	30
		At *Winterhouse*	26	0	N 76	0	120	30

		Northeasting. Deg. M	Latitude Deg. mi		Longitude Deg. mi.
The Northeasting of the first part or space towards the South.	Increasing. 105 Spanish leagues Westwards from *Cape S Augustine* in *Brasile*	0 0	S		0 0
	At *Cape S. Augustine* in *Brasile*	3 10	S 8 30		6 0
	North and South with *Cape das Almas* in *Guinea*	12 15	S 0	0	29 0
	Towards the Northwest Northerly from the Ilands of *Trifian da Cuneha*	19 0	S 31	30	30 0
	Decreasing. Towards the Northwest, Westerly from the same Ilands	15 0	S 31	30	36 0
	North and South with the *Cape of Good Hope*	2 30	S 35	30	57 0
		North westing			
The Northwesting of the second part or space towards the South, except *Goe*, *Cochin*, & *Cantan*.	Incr. 17 German miles from *Cape das Aguillas* Eastwards	0 0	S		60 0
	5 miles in the Sea frō *Terra de Natal*	4 30	S 33	0	66 0
	At the shoalds of *Indie*	11 0	S 22	0	79 30
	In *M sambique*	11 0	S 14	50	81 40
	In the Bay of S. *Augustine* in *Madagascar*	13 0	S 23	30	83 0
	Southwards from *Cape* S *Romant*	16 0	S 28	0	86 0
	In *Anthonie Gills* Bay in *Madagascar*	15 0	S 16	20	91 0
	Decreasing. 34 German miles Southeast from *Brandaon*	22 0	S 19	20	110 0
	In *Goa* a famous Mart town in *Indie*	15 10	N 15	30	120 0
	In *Cochin*	15 0	N 9	45	120 0
	25 German miles West. a little Northerly from the Southwest corner of *Sumatra*	6 0	S 5	28	147 0
	In Bantam a Mart town of *Java*	4 45	S 6	0	150 0
	In the Iland *Luboequa*	2 25	S 6	10	155 0
	In the Southwest corner from the Ile of *Balij*	1 30	S 8	40	157 0
	In the mouth of the river *Cantan* in *China*	0 0	N 23	0	160 0
	In *Bantam* 46 Dutch miles Eastward from the East part of *Java*	0 0	S		160 0

A declara-

A declaration of the form or Table or veiw of variations.

BEfore wee come to the Declaration of this Table, this firſt of all we would not have unknown, namely, that if perchance hereafter by more diligent and more exact experience, any other variation, Longitude, or Latitude of places can be found, then that which is ſet down in this Table, ſo as it ſhould be needfull to change the difinitions and expoſitions of ſome things and words here ſet down: yet we ought not therefore to be ſcared from this purpoſe; but much rather ought we to ſtrive with all our ſtrength to attain thereto, that by little and little we may come to a more certain knowledge of things; building upon theſe as upon foundations: we therefore following this opinion will proſecute that as true, which at this time is moſt like to be true; that if others alſo do the ſame when occaſion is given, we may alwayes come neerer to that which is moſt true in the nature of things.

Which things being omitted, that we may come to the declaration of the former Table, firſt of all we ſay, that the firſt of the three columnes which thou ſeeſt in the Table, ſheweth the variation of the place, the ſecond, the Latitude to which the third is adjoyned containing the Longitudes, as we could by conjecture attain unto them, that the places might ſo much the more eaſily be found in the Globe, and the manner of the variations might more plainly be ſhewed in that which followeth hereafter. The mark of the letter N in the ſecond column, ſignifieth North Latitude, and S South.

Then, becauſe in them mention is made of the variation of the Northeaſting, or the Northweſting increaſing or decreaſing, all which (as proper words of art) have need of there ſeveral definitons: firſt of all we muſt know that the Magneticall needle in one and the ſame place, doth alwayes ſhew the ſame part of heaven, but not the ſame part in all places: for in ſome places it pointeth due North, in other places it declineth more or leſſe to the Eaſt or Weſt. Therefore in manner of a definition, we will ſay thus.

The firſt definition.

THE Declination of the Magnetical needle from the North towards the Eaſt, is called the Northeaſting, towards the

the West, Northwesting; and with a generall name it is called the variation: but the variation and the North pointing of the needle (that is the pointing of the needle due North) *may by a generall name be called the needle pointing, or pointing of the needle.*

As concerning those words of increasing and decreasing, as also of the first and second part or space, before we come to the definitions of them, they have need of some precedent declaration. It may be seen in the Table of variations, that in *Corvo* the Magneticall needle pointeth due North: but after that, the more a man shall goe towards the East, so much the more also shall he see the needle varie towards the East, till he come one mile to the eastward from *Plimouth*, where the variation comming to the greatest is 13 degr. 24 min. From hence the Northeasting beginneth to decrease till you come to *Helmshude* (which place is Westwards from the North Cape of *Finmark*) where again the needle pointeth due North. Now the Longitude from *Corvo* to *Helmshude* is 60 Degr Which things being well weighed it appeareth that the greatest variation 13 degr. 24 minutes at Plimouth (the Longitude whereof is 30 degr,) is in the midst between the places where the needle pointeth due North. For 30 degrees is the midst between the beginning and 60 degrees. And what is here said of the North part, experience teacheth that the same taketh place in the South part also, for 105 Spanish miles from Cape *S Augustine* at the begining of Longitude again it pointeth due North, as it doth 17 Germaine miles from Cape *das Aguillas* (as it appeareth by the Table of variations) which place is in the Longitude of 60 degrees, and in the middest betwixt both at 30 degr. (as in the North part again, there is the greatest Northeasting; of which place there was this mention made in the Table or view of variations: *towards the Northwest Northerly from the Ilands of Tristan de Cuncha*, where the variation is 19 degrees

Out of these we may conclude that the Magneticall needle doth point due North in every place situate in two Meridia: half Circles drawn from the one pole to the other by *Corvo* and *Helmshud*. And that the greatest Northeasting is in all places situate in the Meridian Semicircle drawn by that place, which we said was distant one mile from *Plimouth* towards the East. So as that part of the Earth which is conteyned between two Meridian Semicircles, distant each from other 60 degrees in Longitude, is the space wherein the Magneticall needle alwayes

declineth from the North towards the East. And the half of that part, that is, that portion of the Earth which is included between two Meridian Semicircles, the first of which is drawn by the beginning, the other by the 30 degr. of Longitude, is every where the place of the Northeasting increasing: but the other half is the place of the Northeasting decreasing, to wit when one goeth from the west Eastward, following the order, of the degrees of Longitude.

By this that hath been spoken of the first Segment, with the Northeasting and his parts (in one of which parts the Northeasting is increasing, in the other decreasing) it may easily be understood what the manner of the second Segment is with the Northwesting, and what is the manner of the parts thereof, whereof one is the part of the Northwesting increasing, the other is the part of the Northwesting decreasing: for in the mouth of the River *Cantan* in *China*, at the Longitude of 160 degrees distant from *Corvo*, the needle pointeth due North the third time: there therefore drawing the third Meridian Semicircle the portion of the earth between the foresaid second Meridian Semicircle, and this third (distant each from other 100 degrees in Longitude) shall be the space wherein the Magneticall needle declineth from the North towards the West: and in the middle of both in the Meridian Semicircle 50 degrees distant from the second, and as much from the third, (or otherwise 110 degrees removed from the first Meridian drawn by *Corvo*) shall be the greatest variation of the Magneticall needle, as it appeareth out of the Table of variations in two places, whereof one is in *Williams* Iland at *Nova Zembla*, where the greatest Northwesting is found to be 33 degrees. The other is distant 34 Dutch miles to the Southeast from *Brandaon*, where the greatest variation is found to be 22 degrees, and the Longitude of each of those places is 110 degrees. So as in the half of the second space (which portion of the earth is conteyned between the Meridian Semicircles of 60 degrees Longitude, and of 110 degr.) the Northwesting is every where increasing in the other half decreasing.

Of these 160 degrees of Longitude (which arch wanteth but 20 degrees of half the compasse of the earth) *Plancius* hath attained to the knowledg of the variation, in such sort as now we have shewed. As concerning the other parts of the World, distant either towards the West from *Corvo*, or towards the East from *Cantan*, the experiments which hitherto the hath gotten from the

Spaniards

Spaniards, the Engliſhmen, and our countrymen (the Netherlanders) doe not well agree. Neither is it any marvell, ſeeing they had neither perfect knowledge, nor needfull Inſtruments for that purpoſe: yet he expecteth other experiments from the ſhips which have now been abroad 14 moneths and more. In the mean time we will bring forth that to publique view, which a man may without abſurditie imagine.

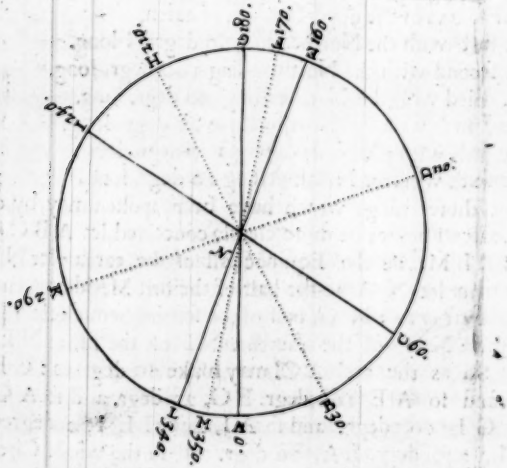
If ſo be that the propertie of pointing due North, take place not onely in the three foreſaid Semicircles (which we conjecture to be Meridian Semicircles drawn from the one Pole to the other) but in the whole Circles alſo; there ſhould then be ſix ſuch Semicircles upon the earth, conteyning alſo between them ſix parts or ſpaces of the upper face of the earth.

The firſt with the Northeaſting 60 degrees long.
The ſecond with the Northweſting 100 degr. long.
The third with the Northeaſting 20 degr. long.
The fourth with the Northweſting 60 degr. long.
The fifth with the Northeaſting 100 degr. long.
The ſixth with the Northweſting 20 degr. long.

That thoſe things which have been ſpoken may by certain Geometricall figures be more clearly conceived, let A B C D E F G H I K L M, be the Equinoctiall of the earth: let N be the Pole: then let N A be the half of the firſt Meridian Semicircle drawn by *Corvo*: N C, half of the ſecond Semicircle: N E of the third: N G, of the fourth: N I of the fifth: N L of the ſixth. So as the arch A C. may make 60 degrees: C E. 100 degr. and ſo A E, 160 degr. E G, 20 degr. and ſo A G, 180 degr. G I. 60. degr. and ſo A I, 240. I L, 100 degrees, and ſo A L, 340 degr. L A, 20 degr. and ſo the whole Circle 360 degrees. Then let the ſix points B D F H K M be the middles between A C. C E, E G. G I, I L, L A. Which being ſuppoſed, A N C ſhall ſignifie the firſt ſpace with the Northeaſting, A N B the Northeaſting of the firſt ſpace increaſing. B N C the Northeaſting of the firſt ſpace decreaſing. C N E the ſecond ſpace with the Northweſting: C N D the Northweſting of the ſecond ſpace increaſing. D N E the Northweſting of the ſecond ſpace decreaſing. E N G the third ſpace with the Northeaſting. E N F the Northeaſting of the third ſpace increaſing. F N G the Northeaſting of the third ſpace decreaſing. G N I the fourth ſpace with the Northweſting. G N H the Northweſting of the 4 ſpace increaſing, H N I the Northweſting of the 4 ſpace decreaſing, I N L the fift ſpace with the Northeaſting. I N K the

Northeasting of the fift space increasing, K N L the Northeasting of the fift space decreasing. L N A the sixt space with the Northwesting. L N M the Northwesting of the 6 space increasing. M N A the Northwesting of the 6 space decreasing.

Note, Though a man may not without cause stand in doubt that the three last Semicircles shall not be found in the same sort, which the former conjecture hath imagined, but peradventure in a quantity either greater or lesser, and in another forme: nevertheless, here the manner is rudely shewed how the whole world



may be divided into certain portions by such Semicircles as shall hereafter be found by observation. Moreover, by that which hath been spoken, it may easily be understood what be the Northeastings or Northwestings increasing or decreasing, what is the first and second Meridian Semicircle, together with the parts or spaces. Which that we may comprehend in form of Definitions, I though good in few words thus to pronounce.

The second Definition.

The Northeasting or Northwesting increasing is that whereby the variation increaseth, the Magneticall needle, being caried from

from the West Eastwards and the Northeasting or the Northwesting decreasing is that whereby it decreaseth.

The third Definition.

The Semicircles of the Meridian, in which the needle pointeth due North, wee call the first and second Meridian Semicircles, and so forwards according to the order of the degrees of Longitude, how many soever such Semicircles there shalbe, beginning at the Semicircle drawn by Corvo.

The fourth Definition.

The portion of the Sphæricall superficies, or round upper face of the earth conteyned by the first and second Meridian Semicircles, is called the first part or space, and the rest in order, the second, the third, and so forth unto the end.

Having thus set down the manner of the variation, it remaineth that we shew by examples (that which before we promised) that although in divers places having the same Latitude there be the same variation also, yet nevertheless the master of the ship may know in what part of the world, and in what place he is. Let us therefore again suppose that a ship had appointed to goe from *Amsterdam* to Cape *S. Augustine*, in *Brasile*, the Latitude whereof in the Table of variations is set down to be 8 degrees 30 minutes, and the variation Northeasting increasing of the first space 3 degr. 10 minutes. The same ship sayling along by the coast of *England*, the variation shall be found to Northeast or varie towards the East dayly more and more untill you come to *Plimouth*, where it cometh to the greatest, and is 13 degr. 24 min. Therefore the Master of the ship shall know assuredly that hitherto he hath sayled in the Northeasting of the first space decreasing, and that after this he shall have the Northeasting increasing, which when he shall find to be 10 degrees in the Latitude of 38 deg. 55 min. then hee may assure himself that he is come to the *Rock* neere *Lisbone*. Going forwards again from thence as it were towards the Southwest, he shall dayly find the Latitude to be diminished, and the Magneticall needle declining towards the North. Or otherwise if the Magniticall needle recline not towards the North, but either stand still or else decline more towards the East, then he may assure himself that hee is carried Eastwards by some secret current not perceived: which

notwithſtanding he may remedy, if he go ſo much the more towards the Weſt, untill the Magneticall needle recover his due variation. But if he ſhould come to the Northeaſting of 3 degr. 10 minutes, before he have his Southerly Latitude to be 8 deg. 30 min. he ſhall then indeavour as much as in him lieth to keep that variation, and ſo ſayle on towards the South part of the world, guiding the ſhip ſo much the more towards the Weſt or Eaſt as occaſion ſhall require. And although he may deem otherwiſe by conjecture, yet he ſhall not follow that conjecture, for the reaſons before ſhewed, for ſo comming to the Southerly Latitude of 8 deg. 30 min. with the Northeaſting increaſing 3 deg. 10 min. he may aſſuredly perſwade himſelf that he is neer Cape *S. Auguſtine*, whereas otherwiſe truſting to conjectures he may very eaſily miſs an hundred leagues of the place to which he had appointed to goe, not knowing in the mean time whether he be to the Eaſtwards or to the Weſtwards from thence; which experience it ſelf hath alſo taught too much in ſuch Navigations. And therefore the Latitude and variation in all places of the earth being obſerved, and the knowledge thereof publiſhed, there ſhall be a much more eaſie way of ſayling about the World, then ever hath been heretofore.

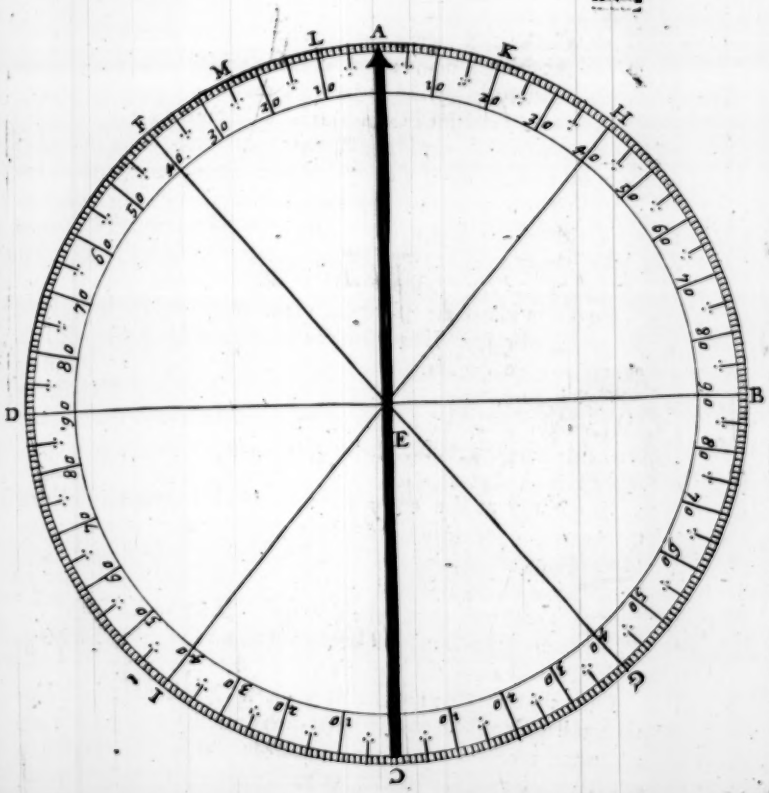
Hitherto we have deſcribed the kinds of the variation which are afterwards declared out of thoſe things which were ſet down in the Table of variations. If the Miſtris of things (experince) ſhall hereafter teach that any thing is otherwiſe, that thing may alſo out of the ſame experience be otherwiſe defined that the Maſters of ſhips in their Navigations may follow that only which ſhall be beſt and moſt profitable.

How the North point, and the variation may be found.

ALthough the finding of the variation, (whereof hitherto often mention hath been made) is known to very many; yet we will in few words ſhew this thing to them which as yet peradventure know not the manner thereof. For here is a queſtion or demand how to find the Declination of the Magnetical needle. Firſt therefore the North point muſt be ſought out, that the pointing of the needle may be compared therewith. The finding thereof in a moveable ſhip hath no ſmal affinity with the finding of the North point or Meridian line on land, and may thus be ſhortly diſpached. In the Inſtrument which ſome call the Sea-directorie ſome the Nauticall box, and we for avoyding ambiguity, name the Sea-Compaſſe, in that Inſtrument I ſay the Flower-

deluce-

deluce ought to agree with the North point of the needle, or wiers lying underneath: or (that which is farr more commodious) in ſtead of the flower-deluce the Magneticall needle may be faſtned above upon the paper or paſtboard, and the limb or circumference of the paſtboard muſt be divided into 360 degrees, beginning at the North point of the needle as you may ſee hereafter in the Circle A.B.C.D, wherein the Magneticall needle is ſignified by A.C. which is faſtned above upon the paper or paſtboard. E is the center. The uſe thereof is this. As the Maſter of the ſhip in ſeeking the Latitude is wont to tarry for the noone-tide, that is to ſay, untill the ſhadow of the Perpendicular ſtile or of the plumb-line agree with the Meridian line in his Inſtrument



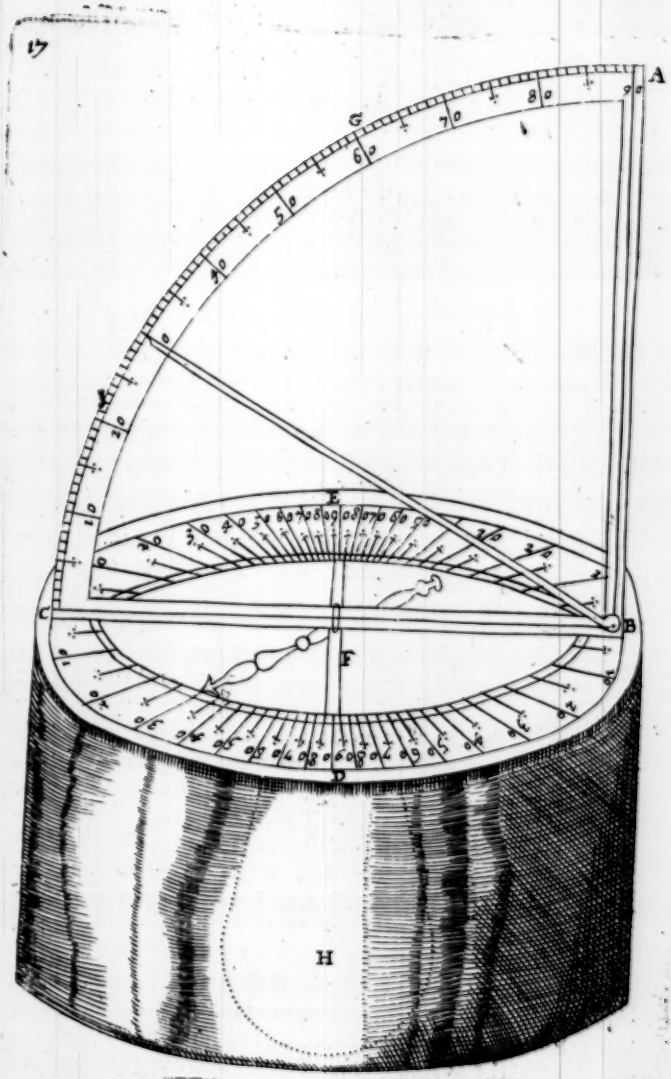
ment: ſo all things alſo do here proceed, but that he beginneth three or four hours before noone, marking diligently into which degree of the Compaſs, or into what diviſion, the ſhadow of the Perpendicular ſtile, or plumb-line falleth. Let us ſuppoſe therefore that he find it in the 40 deg. which we have noted with the letter F. ſo as G.E.F. may ſignifie the whole ſhadow: then hee ſhall ſeek the height of the Sun, which for examples ſake admit hee find to be 25 degrees: which together with the 40 degrees above named, he ſhall note down for helping his memory: After this he ſhall attend till the Sun deſcending afternoon, come to the ſame height of 25 degrees, and he ſhall then alſo diligently mark what place the ſhadow of the Perpendicular ſtile pointeth in the paper, which againe let us take to be 40 deg. to wit, the other way as at the letter H, ſo as now I E H may repreſent the whole ſhadow. Which being done, the midſt of the arch F H (that is A) is the North point: and becauſe the Magneticall needle directly pointeth the ſame, it hath no variation in that place, becauſe it ſheweth due North But if in the ſame experiment after noon the ſhadow had not ſhewed the 40 degr. on the other ſide beyond A, but (for examples ſake) the 20 degr. onely unto K in that caſe the ark F K making 60 degr. ought by imagination to be divided into two parts at L, ſo as L F and L K may make either of them 30 degrees and the variation ſought for may be from L to A Eaſtwards 10 degrees.

But if in the ſame afternoon experiment, the ſhadow of the Perpendicular ſtile L had ſhewed 30 degr. from F the ark F L (conteining 30 deg.) muſt by imagination be divided at M, ſo as MF, ML may either of them contein 15 degrees; which being thus performed, M ſhall be the North point and A the point of variation ſought for, Northeaſting from M to A 25 degr. and ſo in the reſt.

But if the needle onely were turned about and not faſtened to the paper or paſtboord (as before) and the degrees were marked in the margine or limb of the Box, or caſe of the Inſtrument as is ſometimes uſed, there is the ſame manner of uſing it, that was before rehearſed: ſaving that in the beginning of the Obſervation, the Box muſt be turned about ſo farr till the Magneticall needle ſhew the beginning of the degrees.

Others take an Azimuthal or verticall Quadrant, whoſe Horizontall plaine (whereupon it ſtandeth upright) without any impediment received from the motion of the ſhip alwaies remaineth Parallel to the Horizon, in ſuch manner as we ſhall ſhew.

Thus


A
G
E
C
B
F
D
H

Thus the height of the Sun is found, together with the Azimuth.

The fashion of this Instrument may be described after this manner: A B C signifieth a Quadrant of a Circle standing at right Angles upon the Circle B D C E devided into 360 degrees, whereby the plain of the Horizon is signified. The center thereof is F, upon which the Quadrant may be turned about: and that it may alwayes remain at right Angles upon the Circle B D C E it is under-propped on both sides from G to D and E and those props are fastned to the same quadrant, that they may be turned about together with it. Moreover in the Circle B D C E there is a glass and under the glass a Magneticall needle, which must be so long as the box may suffer it. And the box or case hath within it 360 degrees, which the magneticall needle may precisely point unto, which likewise doe agree with as many other degrees inscribed into the Horizontall plain.

This Instrument was made according to the invention of *Reginaldus Petrans*, hanging upon two Axtrees like the Sea-Compass, that so the Circle B D C E notwithstanding the motion of the ship, may alwayes bee equally distant from the Horizon. And that this may be done with the greater securitie the weight marked with the letter H is adioyned underneath, conteyning 25 or 30 pounds, or so many as the greatness of the Instrument shall require. But this also is worthy to be noted, to wit, that the Quadrant Perpendicularly erect in his place is of the same weight on both sides of the center, that is to say, the side from F to C counterpoyseth the side from F to B, which may be known if a man take up the Quadrant, hanging it with G downwards, the thred being fastned in the middest of B C at F, and then cut off so much of the heavier part, as may suffice, that the line B C may hang levell. But because some man may object that the Ruler or Index which the barbarians call the *Alhidada*, may bring a great variety in the weight as it shall be turned higher or lower: wee must know that any such thing need not to bee greatly feared because of the great weight H, and the lightness of the Ruler.

The use of this Instrument in finding the North point and variation is this: you must begin to Observe (as in the former kind) certain hours before noon, and the instrument must be turned untill the Magneticall needle point to the beginning of the Circle: then the Quadrant must be turned this way or that way, and the sight Rule of the Quadrant must be lifted up or put down till the Sun shine through the sight. All which being done,

done, ſuppoſe it bee found (for examples ſake) that the utmoſt Margine or Index of the Quadrant ſhew in the Horizontal plain 40. degr. and admit the heighth of the Sun be alſo found to be 25 degrees, which together with the 40. degrees he ſhall for memories ſake have need to note. And when he hath expected afternoon till the Sun deſcending by the ſame Inſtrument be found placed in the ſame 25. degr. of Altitude, then the Box it ſelf muſt again be turned this way or that way, untill (the Sun again ſhining through the ſights) the Magneticall needle doe point to the beginning of the Circle. Which things being thus diſpatched, the middle point of the arch in the Horizontall plain between the firſt and ſecond experiment is the North point, and how much the needle declineth from that point, ſo much is the variation ſought for, as before wee have ſhewed in the firſt example more at large.

Whatſoever we have affirmed to be available in the day time, in theſe experiments of the Sun, the ſame may be underſtood and done in like manner in the night, by any of the fixed ſtars, whereof there is the ſame uſe in this matter that there is of the Sun. But there is not the ſame reaſon of the Moon, aſwell becauſe of the ſwiftneſſe of her proper motion, as alſo becauſe of the greatneſs of her Parallax (as they call it) which the overmuch neereneſs of the Moon to the Globe of the earth bringeth forth. But this alſo is to be noted that two, three, or four, yea and more Obſervations may be made in the foore-noon. As for example, let the firſt bee when the Sun is 10 degrees above the Horizon, the ſecond when it is 15. degr. the third when it is 20. degr. and if any man will make triall as often after noon, hee ſhall ſee how every experiment agreeth with other, and when at every moment the ſame North point is found, that thing ſhall give the Maſter of the ſhip no ſmall courage, and more certain confidence of his work.

But notwithſtanding, when the Mariner ſayleth from the Eaſt Weſtwards, or contrariwiſe from the Weſt Eaſtwards, it may be that in the ſpace of 10 or 12 hours between the firſt and ſecond experiment, there may be difference of one degree or more in the variation, whereof may follow that the North point found by the firſt forenoon Obſervation, and the laſt in the afternoon, ſhall not agree with that which was found by the firſt in the afternoon and the laſt in the forenoon: when notwithſtanding the Mariner hath not erred in Obſerving.

Which if it ſhall happen often, the skilfull Mariner may judge

thereby what difference of variation is anſwerable to any determinate time of ſayling, and ſo find a way whereby the North poynt may be found with more certainty and ſecurity: which thing may thus alſo be done. if a man diligently compare the variation found in the former days with the variation which he preſently ſeeth.

FINIS